THURSDAY, FEBRUARY 22, 1877

A WORKING NATURALIST

Life of a Scottish Naturalist: Thomas Edward, Associate of the Linnean Society. By Samuel Smiles. Portrait and Illustrations by George Reid, A.R.S.A. (London: John Murray, 1876.)

IT is rather a delicate thing and seldom advisable to publish a full and formal biography of a man with an account and attempted estimate of his work while he himself is still alive and in comparative vigour. There are many sound reasons, however, to justify Mr. Smiles in telling the wonderful story of the still living Thomas Edward, the Banff shoemaker and naturalist; not the least weighty of these is that it will bring to Edward some of that *kudos* and cash which he has earned long ago, and which it would have been well for himself and for science had they, or at least the latter, reached him years since.

Thomas Edward, born 1814, is the son of very humble but thoroughly respectable Scotch parents, who were able to bestow upon him the scantiest schooling. He was brought up in Aberdeen, where he was in rapid succession expelled from three schools on account of his intense inborn passion for "everything that hath life." He used to take all sorts of birds and beasts and creeping things to school with him, in his pockets, in boxes, or in bottles. Tom's specimens would often escape, and the scene may be imagined when some unconscious urchin realised that a snail, or a horse-leech, or a "Maggie-mony-feet" (centipede), was crawling up his bare legs. Poor Edward meant no harm, but it was too much to expect that an ordinary dame or dominie would, in that remote and unscientific age, at least, take the trouble to understand the boy's nature and tendencies and aspirations. The consequence was severe thrashings and expulsion.

When Edward left school finally he was only six years old, could read with difficulty, and could hardly be said to be able either to write or count. After serving for some time in a mill he was apprenticed to a shoemaker, Begg, "a low-class Cockney," Mr. Smiles calls him, and certainly a regular brute, who treated the poor boy and his birds and beasts in a most cruel fashion. However Edward managed with this man and a subsequent master to pick up a fair knowledge of the shoemaking trade, and after vainly trying to emigrate as a stowaway, removed to Banff when about twenty years old, where he has lived ever since working as a journeyman for wages, and devoting every moment of his leisure to the gratification of his passion for natural history. It is common enough for working men, and especially for shoemakers, to take an interest in certain animals, especially in birds; but Edward's fondness for animals was no fancy of this sort. From almost his infancy he was devoured with a passion for the observation and possession of animals of all kinds; to him no living creature was unclean or loathsome, and he feared to face or handle nothing from a centipede or an adder to a polecat. While yet a baby in his mother's arms he nearly put a premature end to his career by springing to clutch at a passing insect; and while being drilled as a militiaman in Aberdeen he made himself liable to severe punishment by rushing like a madman from the ranks in chase of a passing butterfly.

As a journeyman shoemaker Edward had to work from six in the morning till nine at night. Shortly after settling in Banff he married, luckily for his love of nature, a prudent and considerate woman, who, instead of thwarting his eccentricities, did what she could to help him and enable him to indulge them. "Weel," she said once, when asked what she thought of his habits, "he took such an interest in beasts that I didna compleen. Shoemakers were then a very drucken set, but his beasts keepit him frae them. My man's been a sober man all his life; and he never negleckit his wark. Sae I let him be." "Wise woman!" justly adds Mr. Smiles. Shoemakers' wages in Banff were very low—only a few shillings a week. For many years Edward earned only about 10*s.* a week, and yet on this he managed to rear, without incurring debt, a thoroughly respectable and honest family of about a dozen children, who have repaid their parents' care by doing what they could to comfort their old age. Edward being a man who had a proper sense of his duty to his family, seldom thought of allowing his favourite pursuit to encroach on his long working hours. As his consuming passion must be satisfied, he took the only course legitimately open to him; he gave up his nights to it. As soon as he got home from work, unless indeed the weather was unusually bad, he shouldered his gun, equipped himself in his eight-pocket coat, four-pocket vest, double-storied hat, and other traps of a rude but efficient enough kind, and putting his supper of oatmeal cakes in his pocket, set out to watch and catch the denizens of the woods, heaths, air, and sea-shore of the region around Banff. He would prowl about as long as the light permitted, lie down for an hour or two in a hole, under the lee of a bush, inside some old ruin, or underneath a flat tombstone in some eerie churchyard, snatch an hour or two's sleep, and be up again with the first streak of dawn. Even when thus resting, however, he would frequently be kept awake watching the doings of any night animals that might be near him. Frequently also his rest was a very broken one. He might be wakened by a weasel or a pair of rats or some other inquisitive or hungry creature tugging at his coat-pockets or trying to make their way underneath his hat, always well filled with insects, birds, or eggs. He gives a most exciting description of a two hours' struggle with a pole-cat that attacked him while resting in darkness in the ruins of Boyne Castle. He was dreadfully lacerated by the claws of the animal, but this he did not mind, so long as he succeeded in keeping the skin of the pole-cat whole. Once he spent two days and a night, without sleep or food, in watching a Little Stint (*Tringa minuta*), which he sighted on the shore near Banff, and thought himself amply rewarded by being able at last to capture it. As might be expected, in his unconscious eagerness to follow out his pursuit, he met with frequent accidents, and was once or twice within very little of losing his life by falling down high precipices. All this, however, he took as "in the bond"—as no more than might be looked for by one in his circumstances persisting in gratifying a passion of the kind that consumed him.

When compelled to stay at home Edward occupied himself with the preparation of his collections and the

making of cases for holding them. In no long time every corner of his house was filled with cases, and he wisely determined to turn an honest penny by exhibiting his treasures. This he did on two or three occasions in Banff on fair days when the town was filled with country people. These exhibitions were so successful that he resolved, by the advice of his friends—it was all the help they ever gave him—to try a wider sphere, and he rented a room in Aberdeen, where he arranged his collection. Many of the groups of animals were most artistically put together, and as a mere sight, not to speak of its scientific value, the exhibition was well worth visiting. But it proved a complete failure; only a few people dropped in. It was a serious matter to Edward, for of course he had to leave his work and necessarily incur what were for him considerable liabilities. The prospect was so gloomy that he was driven to think of the last resort of despair, suicide. He went down to the mouth of the Dee, and had divested himself of his outer garments preparatory to taking a last plunge, when a strange bird hopping about on the sand caught his eye. His ruling passion asserted its sway, and off he set on a long and exciting chase to discover the nature of the bird; in this he failed, but the chase left him a more cheerful and a wiser man. He was compelled to sell his collection for about 20*l.*, returned to Banff and resumed his work and gradually his old habits, and ere long had the pleasure of seeing another collection gradually accumulating. More than once afterwards had he to sell his collections, which he regarded as his savings' bank to fall back upon in time of need. But his ardour was never damped, and until prevented from wandering far by rheumatism and other results of his hard life, he never ceased adding to his store.

Edward's collections not only included quadrupeds, birds, and insects; plants of all kinds came in for a share of his attention, and, latterly, marine animals of all kinds; in the last field, especially, he did work of the highest value. Except one or two clergymen of similar tastes, the dreadfully respectable people in and about Banff took no notice of Edward, whom they seem rather to have shunned as eccentric, if not crazy. But gradually naturalists in various parts of England came to know of him, and thus he got into correspondence with well-known workers in various parts of England. One of his principal correspondents was Mr. Spence Bate, who, during the preparation of the "History of the British Sessile-eyed Crustacea," obtained important help from Edward. The latter collected for and sent Mr. Bate a very large number of specimens. Of 294 Crustaceans found in the Moray Firth, no fewer than twenty-six new species were added by Edward himself. A new Isopod which he discovered was named after himself *Praniza* (*Anceus*) *Edwardii*, and one of his most notable discoveries was one of the little fishes known as midges, which he sent to Mr. Couch, who pronounced it new to science, and named it Edward's Midge (*Couchia Edwardii*). By and by he was induced to send descriptions of his observations first to the local journal and latterly to such scientific journals as the *Linnean Society's Journal*, the *Zoologist*, *Naturalist*, and *Ibis*. No one reading Edward's accounts of his experiences would ever dream that their author had had no schooling after his sixth year, and had worked nearly all his life from 6 A.M. till 9 P.M. at a common handicraft. They have been compared without any exaggeration to the classical descriptions of Wilson and Audubon.

How Edward, with no dredging apparatus whatever, but only with old pots, pans, rags, from seaweed cast ashore, from the inside of fishes obtained from the fishermen, and by other similar methods, collected his marine specimens, many of the greatest rarity, is well told in Mr. Smiles's narrative. It is quite amazing how much is yet to be learned about the commonest objects of our land and sea; and how much of new Edward managed to discover of the nature and habits of animals about which one would have thought no more was to be learned. In an appendix of forty-eight pages Mr. Smiles gives a descriptive list of a portion of the Fauna of Banffshire observed or found by Edward; had all that he has found been thus catalogued it would have filled the volume.

It is to the credit of the Linnean Society that years ago they conferred upon Edward the rare honour of Associate. Doubtless had the numerous correspondents whom he was so ready to help with specimens and the result of his observations known of his real condition, they would have done something to put him in a position in which he could have helped science with less hardship to himself. Here, surely, if ever there was one, was a fair case for the endowment of unremunerative research, and had the fund now being allotted been in existence even ten years ago, Edward would have had a prime claim upon it. How these things are managed in Norway may be learned from the following extract from a letter from Mr. A. Archer, Laurvig, Norway, to the *Times*, called forth by reading Edward's Life:—

"Some years ago there lived on the wild west coast of Norway a clergyman, with his wife, a large family, and a small income. He, too, employed every leisure hour in the study of nature, but being a graduate of Christiania University, and being obliged to take many a journey over the large fiords in visiting distant parts of his parish, he possessed two great advantages over Edward—a good education and larger opportunities of observation. He, too, had the seeing eye without which all opportunities are useless, and shortly it was known that science was being enriched with discoveries in zoology made by the hard-worked parish priest. The action of the Norwegian Storthing was prompt. Though the great majority of that body are poor peasants, with little more education than they have picked up in the parish school, and though in all ordinary cases they hold the purse-strings with a grip that would have pleased Joseph Hume, they have the virtue of being liberal when good cause can be shown for it. At the request of the Governing Body of the Christiania University they created a new unattached Professorship of Zoology, endowed it with a salary of 333*l.*, equal to 1,000*l.* in England; and, relieving the clergyman from his parish duties, which could be well performed by another, appointed him to the professorship, but without requiring from him either residence or teaching. How the Professor, in these favourable circumstances, went on enriching science with his discoveries till his name became famous over the world, how he trained up his sons to follow in his footsteps, how two of them, though yet young men, are professors in Christiania University, one of them in his own favourite science, all this is known to the scientific men of Europe, nor, should any of them read this, will they require to be told that the name of the clergyman was Sars. It would, of course, be absurd to ask the enlightened Parliament of Great Britain to take in the case of Edward a hint from the Norwegian Storthing in the case of Sars, and the

Scotch Universities are, we all know, too poor to create unattached professorships and endow them, standing as they do rather in need of endowment. Is it equally absurd to ask if one of the wealthy English Universities would not consider it an honour to rank Edward among its professors, and assist him to publish the observations he may yet have time to make, or does it merely show gross ignorance of the spirit in which they are governed to suppose that either of them could so far depart from the usual routine? I suppose I am not the only countryman of Edward who, having lived here long enough to learn how poor Norway treats her great men, will regret—not so much on account of Thomas Edward, for his has been a great life and example, but in the cause of science—that his lines have not fallen in pleasanter places."

But Edward never complained of his lot, and had Mr. Smiles not written the present work, he would have had to stick to his stool to the end. All Edward ever wanted was some way of earning a living that would have enabled him to give more time and attention to his scientific pursuits, and no one will deny that it would have been immensely to the gain of science could his services have been devoted entirely to it, for he was too passionately fond of nature ever to have been spoiled by prosperity. But regrets are now useless; happily Edward is not beyond the reach of consolation and well-merited reward, and happily he is receiving them. He will be mentioned in the annals of science as an observer of the highest accuracy and originality, who gave up to a parish a genius fitted for an immensely wider sphere. The obvious moral of the work to those who have to spend most of their time in earning their daily bread, as well as to others, we need not point here. Mr. Smiles's work is one of the most interesting biographies ever written, and the illustrations gratuitously contributed by Mr. Reid are a great pleasure. Our readers by buying the book will not only become possessed of a rare treat, but will at the same time help to confer a substantial benefit upon Thomas Edward, the Scottish Naturalist.

BLAKE'S "ASTRONOMICAL MYTHS"

Astronomical Myths. Based on Flammarion's "History of the Heavens." By John F. Blake. (London: Macmillan and Co., 1877.)

IN the continual turmoil of daily life, when each one is looking forward to new methods and new discoveries, we seldom or never look back into the doings of our early predecessors, and even when we do we are somewhat inclined to pity their ignorance and their, to us, absurd notions. We ought rather to call to mind the difficulties under which the great men of old laboured, difficulties under which our present leaders in astronomy would probably have been equally sorely tried. We must remember that we have all the sister sciences lending their aid, and that therefore the advance in astronomy should be made with constantly increasing strides.

The author of this work has put before us the labour of M. Flammarion in an English dress, and has added other matters—notably a chapter containing the researches of Mr. Haliburton on the Pleiades, to many the most interesting part of the book. We are carried back to the time when nations thought as the child did in the lines of Tom Hood, quoted by the author:—

"I remember, I remember, the fir trees straight and high,
And how I thought their slender tops were close against the sky;
It was a childish fantasy, but now 'tis little joy,
To know I'm further off from heaven than when I was a boy."

Mr. Blake commences by calling attention to the contemplation by our ancestors of the awe-inspiring phenomena of the heavens by night, the rising and setting of the sun, moon, and planets, the slow and silent motion of the constellations from east to west. To them the sky was a lofty canopy studded with stars, the earth a vast plain, the solid basis of the universe. Two distinct regions appeared to compose the whole system—the upper one, or the air, in which were the moving stars, and the firmament over all; and the lower one, the earth and the sea.

It is to be expected that in early times religious beliefs and rites were mixed up with and were derived from the motions and appearance of the heavenly bodies. The Druids appear to have seen or imagined that the moon was a body like the earth, having mountains, and, according to Plutarch, furrowed with several Mediterraneans, which the Grecian philosophers compared to the Red and Caspian seas. This celestial earth was supposed by the western theologians to be the abode of departed souls, the place of immortality. The festivals were therefore ranged accordingly, and the Druids were represented as holding a crescent in their hands.

The origin of the names of the constellations has always been a source of speculation, and the chapter on this subject is well worth study. For the names of several of them there appears to be some show of reason, but others have been named from mere caprice, or in honour of some person or event. In the case of the "Locks of Berenice," the story goes that Berenice was the spouse and sister of Ptolemy Euergetes, and that she made a vow to cut off her locks and devote them to Venus if her husband returned victorious, and, to console the king, the astrologer placed her locks among the stars. The Great Bear, the Ἄρκτος μεγάλη of the Greeks, the Okouari (bear) of the Iroquois may have been so called, as Aristotle observes, because the bear is the only animal that dared venture into the regions of the north. The Arabs called the bears the great and little coffins, and the Christian Arabs made the Great Bear the grave of Lazarus, and the three weepers Mary, Martha, and their maid.

The history of the signs of the zodiac is traced downwards in the several nations, and it is pointed out that the names may have originated in the rising of constellations at the times of certain important events, as Aquarius at the time of the inundation at Thebes, and the Bull at the time of ploughing, but this does not account for all. Further, we find how the precession of the equinoxes furnishes us with a means of fixing the date of the signs receiving their names; at that date the names of the signs of course corresponded to the zodiacal constellations, and if we find in any description that the equinox is said to be in the sign of the Bull we know that the method of naming dates back to some 3,000 years ago, for at that period the equinox happened in the constellation of the Bull. According to our present nomenclature the equinox happens in Aries, but really when the sun is in Pisces; our method therefore dates back to about 2,300 years ago when the equinox was in the constellation of

Aries, or more probably to the time of Hipparchus, when the equinox was exactly at the star β Arietis. It occurs to us that the worship of the Bull and Golden Calf was in vogue during the time that the equinox happened in the constellation of Taurus, that the Ram and Lamb were held in estimation at a later date when the equinox happened in the constellation of Aries.

The most prominent group of stars in the heavens—the Pleiades—has always been an object of attention, and we are glad to find an interesting chapter on this subject based on the careful work of Mr. Haliburton. The Pleiades, we learn, were observed for the purpose of dividing the year into two parts—one "the Pleiades above," and the other "the Pleiades below." During one half-year, while they were east of the sun, they would be visible at sunset and the reverse during the other half. The culmination of the Pleiades at midnight appears to have been with many nations the starting-point of the year, and here again the precession of the equinoxes has an interesting effect, since the tropical year is shorter than the sidereal. Thus the dates of the latter keep advancing on those of the former, and so long as dates were regulated by the stars all the countries would agree in the time of their festivals; but, as the author puts it, "as soon as a solar calendar was arranged, and it was found that at that time this position coincided with a certain day, say the Pleiades culminating at midnight on November 17, then some would keep on the date November 17 as the important day, even when the Pleiades no longer culminated at midnight then, and others would keep reckoning by the stars, and so have a different date."

The instance given of the 17th November seems to be somewhat strange, for, on referring to our star maps, it appears that the Pleiades culminate now at midnight on or about the 14th November, and years ago the midnight culmination took place of course earlier in the year. It is, however, possible that judgment of the date of midnight culmination was in error.

Mr. Blake then goes on to point out that a new year's festival determined by the Pleiades is the most universal of customs. The Australians hold their new year's corroborree in November at the midnight culmination, and in India the year was determined by the Pleiades, and on the 17th day of November is celebrated the Hindoo Durga, the festival of the dead, and new year's commemoration. So also the Egyptians regulated their solar calendar that the day might be unchanged, and the commemoration of the dead took place on the 17th of their month Athyr, the same date at which the Mosaic account of the deluge makes the same commence. This, we agree with the author, is no chance coincidence.

We cannot think, however, that the explanation of the origin of November 17 is clear, for although some 4,000 years ago the equinoctial point was close to the Pleiades, there appears no particular reason that the day on which the equinox happened when near that group would be called November 17, and if it was so called how comes it that the midnight culmination happens now within three days of the same date, while our calendar has continually been changing with reference to sidereal events? If we assume that the commemorations of India and other places are kept on the day of midnight culmination of this group, without reference to the calendar, then the events would happen now without much error on November 17, and will happen on December 17 some 2,200 years hence, and if we reckon back according to our calendar to a time—to some 4,000 years ago—the culmination and festivals would have happened on the autumnal (spring of the southern hemisphere) equinox—September 21. We do not see from the text how the Egyptian and Mosaic dates of November 17, although perhaps connected together, can have any connection with the festivals of other nations kept on that date in modern times. The calendar might have been arranged to suit the sidereal year up to a comparatively late date, but our calendar has been fitted to the tropical year much too long to allow, at its commencement, the midnight culmination of the Pleiades to have happened anywhere near November 17.

In other words, the festivals depending on the midnight culmination of the Pleiades will necessarily be kept on or about the same day, and that day happens to be February 14, or, say November 17; now unless the calendar be a sidereal one, which it is not, this festival must have, in bygone years, happened earlier than November 17. It would seem, therefore, that some other event than the culmination of the Pleiades happened, by which the Mosaic and Egyptian date of November 17 was fixed.

The further account of the Pleiades and the relation to the passage in the Pyramid of Gizeh, as investigated by Piazzi Smyth, is extremely interesting.

In the chapter on astronomical systems there is much worth reading, and the diagrams show the gradual advance of observation and order over imagination, and it seems curious to us at the present time that the ancients should have gone so far out of their way to describe the earth as a flat surface floating, with roots, on pillars, on the backs of elephants standing on a tortoise, as a portion of a cylinder, as cubical, or as having various other forms. The geography and cosmography are no less interesting, and a large number of diagrams of maps are given, many of which appear to have been made to suit the superstitious ideas of the fathers of the various churches rather than the results of observation.

The chapters on Eclipses and Comets, with the anecdotes of the consternation and awe produced by their appearance, give us a very correct idea of the all-supreme superstition of the middle and earlier ages; but even now among civilised nations there appears to be a large amount of superstition to be eradicated.

OUR BOOK SHELF

Acoustics, Light, and Heat. By William Lees, M.A., &c. Glasgow: Collins, Sons, and Co., 1877. (Collins's Advanced Science Series.)

THIS is a good specimen of a series of text-books, among which Dr. Guthrie's capital compendium of Magnetism and Electricity, and several other valuable works have appeared. It is stated, in a brief preface, to be founded on notes of the late Dr. W. S. Davis of Derby, who was to have undertaken its preparation, and to whom the first chapter, as well as the Appendix on the Doctrine of Energy, are due.

Text-books are far from easy to write in a satisfactory manner; by their very definition and nature they contain no novelty, except such as can be secured by clear treatment and lucid exposition of subjects already familiar.

They are, moreover, being issued in such numbers, under the present demand for popular education, that their very likeness to one another is fatiguing. They require also in their construction the rare faculty, whether intuitive or gained by long experience, of insight into a student's probable difficulties; for it seems desirable that they should rather aim at being employed as condensors and systematisers of knowledge already acquired generally from the study of larger and more diffuse treatises, than as independent works. It is in this respect that useful practical knowledge differs from "cram"; a distinction very real, though more difficult to define than to understand. The concentrated food offered by such compilations is less easy of digestion, and more readily expelled from the mental economy, than that which is more gradually administered and more completely assimilated.

The writer of the present manual has, for instance, only seventy pages to devote to Sound, one hundred and eighteen to Light, and ninety-one to Heat, exclusive of the Appendix. But it is remarkable how much he succeeds in compressing within these very restricted limits. The illustrative experiments are, as a rule, simple and well chosen, though occasionally trite, and even of doubtful accuracy; as is seen in the drawing of the periodic curve of a musical sound at p. 40, and that of dispersion of light on p. 135. On the other hand, the use of a long spiral steel spring to illustrate waves of compression and rarefaction, the description of the effects of Temperature on Sound-waves, and the chapters on Interference, Diffraction, and Polarisation of Light, especially in its Circular and Rotatory forms, are ingenious and easy to comprehend.

A few simple numerical examples are given of each important law, with their solutions, and the mode of working out; a method which probably tends more than any other to fix essential points on the memory of the student.

W. H. STONE

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Postulates and Axioms

A STRONG committee, appointed, or rather re-appointed, for the purpose, reported last year to the British Association upon the Syllabus drawn up by the Association for the Improvement of Geometrical Teaching. I have only just seen a copy of the report, and I wish to point out that it incidentally touches in a misleading fashion upon a matter which, though primarily of only historical interest, is really of theoretical importance too, if not (in the strictest sense) for the special purpose of the committee; I mean upon the different ways of distributing the fundamental assumptions under the two heads of postulate and axiom.

Let us stop for a moment at the historical point of view. It is well known that the received text of Euclid, which we may consider represented by David Gregory's edition (Oxford, 1703), misplaces the assumption about right angles, the assumption at the base of the theory of parallels, and the assumption that two straight lines do not inclose a space. That is to say, whereas in the correct text these are the 4th, 5th, and 6th postulates, the received text makes them the 10th, 11th, and 12th common notions, or, as we usually say, axioms.

Now, when the report speaks of Euclid in this connection, it means something nearly identical with the received text. Not quite, however; for, though the language is not clear in all respects, it clearly says thus much, that Euclid divided the axioms into general and specially geometrical. But this is not the case in either text; for in both texts the first seven common notions are general, the 8th geometrical, and the 9th general again, nor is the 8th distinguished from the rest by its grammatical form. But whether you follow the received text or depart from both, it is unhistorical to affirm of Euclid what is not true of the correct text.

Let us now consider the theoretical significance of the two distributions. The case is thus stated by De Morgan, under *Eucleides*, in Smith's "Dictionary of Greek and Roman Biography," p. 66b:—"The intention of Euclid seems to have been to distinguish between that which his reader must grant, or seek another system, whatever may be his opinion as to the propriety of the assumption, and that which there is no question everyone will grant. The modern editor merely distinguishes the assumed *problem* (or construction) from the assumed *theorem*." This latter distinction is at least as old as Proculus; but to De Morgan it is Euclid's, at least as concerns right angles and parallels, that "seems most reasonable; for it is certain," he continues, "that the first two assumptions can have no claim to rank among common notions or to be placed in the same list with 'the whole is greater than its part.'" We need not pursue the modern editor's distinction further; but Euclid's acquires a more definite significance in relation to those generalised conceptions of space which, since De Morgan wrote these words, have almost passed into popular science. This in its generality is a difficult subject, but for the present purpose it is enough to regard plane geometry as a particular case of the geometry of points and lines on a given surface.

In this view the postulates specify the attributes of the plane which make plane geometry what it is. Thus the first three, whatever else they do, provide that the power of drawing diagrams shall not be restricted by boundaries, and the fourth, "all right angles are equal," affirms that a complete rotation is the same in quantity at all points; thereby the first three exclude surfaces having such a singular locus as a cuspidal line, and the fourth excludes surfaces having such a point as the vertex of a cone. Again the fifth excludes anticlastic surfaces, and the sixth synclastic ones and any which, like the common cylinder, returns into itself. Nothing remains but the plane and such developable surfaces as the parabolic cylinder to which *mutatis mutandis* everything in plane geometry will equally apply.

The axioms, on the contrary, specify no property of any class of surfaces. This is crucially instanced in the one axiom (the 8th, that things congruent are equal) which does concern figures traced on surfaces of only a limited class. For this axiom merely says that if things coincide they are equal, not that figures in different places may be brought to coincide.

The question may be asked whether this last assumption ought not to be premised somewhere; that is, whether the method of superposition ought not to have been vindicated by expressly assuming that any plane figure may be laid down on any plane so as to coincide with a portion of it. The omission is an extremely curious fact—in Euclid, I mean, for it is not at all remarkable in his successors. On the one hand, express statement is superfluous in the sense that the assumption is implied in the last two postulates; for the fifth affirms that the "measure of curvature" of the plane is not negative, and the sixth that it is not positive; between them it is naught, and therefore constant; but this is the condition of superposableness. On the other hand, express statement is indispensable in the sense that the student cannot do without it, because the theory of measure of curvature does not belong to elementary geometry.

The fact is that Euclid has drawn the line with what is really remarkable accuracy, but is only seen to be so in virtue of principles not discerned, I believe, by any one before Gauss. Whatever may be the explanation of this phenomenon, to ignore it in speaking of Euclid's postulates and Euclid's axioms is to depart from history where adherence to history would be instructive in theory too.

It is of course another question whether this distinction of Euclid's ought to be preserved in books intended to supersede Euclid.

C. J. MONRO

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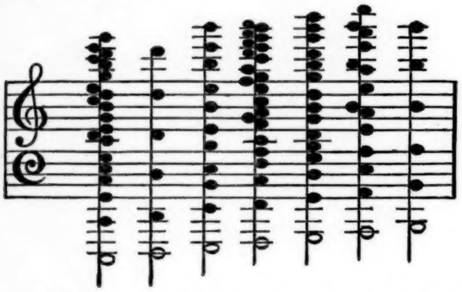
Just Intonation

THAT Mr. Chappell misunderstands me is due partly to his confounding vibration numbers with their ratios. Thus $\frac{27}{16}$ is the vibration number of the supertonic, where $\frac{3}{2}$ is that of the tonic; while 524288 is not the vibration number of any musical sound, though the ratio $524288 : 531441 = 2^{19} : 3^{12}$ expresses an interval that may be picked out fourteen times in each octave of Mr. Colin Brown's keyboard. A still more complex interval $2^{22} : 3^{14}$ is found seven times in each octave.

I have followed Mr. Chappell's advice and purchased his sixpenny pamphlet, and having read it with the care it deserves, I can only say I dissent from a great part of it, especially where

harmonics and the scale are treated of, and I am not surprised that its author cannot understand the numerical basis of Colin Brown's Just Intonation Harmonium.

The strict harmonic chords of the seven notes of the scale, including only sounds in the scale of C, and excluding all approximations, are these :—



Here it will be observed that all the tones of the scale are harmonics of F and of that note only (a circumstance first pointed out by Colin Brown). I do not admit that F and A are notes *interposed* in the scale of C. A. R. CLARKE

Ordnance Survey Office, Southampton, February 8

Protective Mimicry among Bats

I HAVE read with much interest the remarks of Dr. S. Archer in NATURE, vol. xv. p. 313, on the habits of *Rynchonycteris naso*, Wied. (= *Proboscidea saxatilis et rivalis*, Spix.), as they quite agree with notes on the same species made by me when travelling some years ago in British Guiana.

This is not, however, the first published notice of protective mimicry among bats. In my "Monograph of the Asiatic Chiroptera" (1876), I have referred to the peculiar markings of the wing and interfemoral membranes in *Kerivoula picta*, *Vespertilio formosus*, and *V. Welwitschii*, which are coloured on the same plan although these species are related in no other respects, and have stated that I believe these markings to be the result of "protective mimicry." Of one of the two first-named species, Mr. Swinhoe remarks :—"A species of *Kerivoula* allied to *K. picta* and *K. formosa*, was brought to me by a native. The body of this bat was of an orange brown; but the wings were painted with orange-yellow and black. It was caught, suspended head downwards, on a cluster of the round fruit of the Longan-tree (*Nephelium longanum*). Now this tree is an evergreen; and all the year through some portion of its foliage is undergoing decay, the particular leaves being, in such a stage, partially orange and black. This bat can, therefore, at all seasons, suspend from its branches, and elude its enemies by its resemblance to the leaf of the tree. It was in August when this specimen was brought to me. It had at that season found the fruit ripe and reddish-yellow, and had tried to escape observation in the semblance of its own tints to those of the fruit." [1]

A familiar instance of what appears to be "protective mimicry" occurs in the species of the genus *Pteropus* (Flying-foxes of European residents in India). These, the largest of all bats, measuring, on an average, nearly one foot in length with an expanse of wing of from four to five feet, are, from their large size, very conspicuous objects even when the wings are closed, and easily seen from the ground when hanging from lofty trees. With very few exceptions these bats have the fur of the back of the head and of the nape of the neck and shoulders of a more or less bright reddish or bright buff colour, contrasting strongly with the dark brown or black fur of the back. At first sight it might appear that this remarkable contrast of colours would render the animal more conspicuous to passing enemies, and consequently more subject to their attacks when hanging in a semi-torpid condition. But any one who has seen a colony of these bats suspended from the branches of a banyan tree, or from a silk cotton tree (*Eriodendron orientale*), must have been struck with their resemblance to large ripe fruits, and this is especially noticeable when they hang in clusters from the leaf-stalks of the cocoa-nut palm, where they may be easily mistaken for a bunch of ripe cocoa-nuts. Hanging close together, each with his head bent forwards on the chest, his body wrapped up in the ample folds of the large wings, and the back turned outwards, the brightly coloured head and neck is presented to view, and resembles the extremity of a ripe cocoa-nut, with which this animal also closely corresponds in size.[1]

The much smaller species of *Cynopterus* and *Macroglossus*, which feed on the fruit of guavas, plantains, and mangoes, resemble these fruits closely in the yellow colour of their fur and in their size, so that it is very difficult to detect one of these bats when suspended among the leaves of any of these trees.

The resemblances, however, between these frugivorous bats and the fruits of the trees on which they roost, may be accidental, and, in the present state of our knowledge, we would scarcely be justified in setting them down as the result of "protective mimicry," though there can be little doubt that, to whatever cause due, they aid in concealing these animals from the attacks of enemies.

I could adduce other instances of what appear to me to be cases of "protective mimicry" among bats, but my letter has already much exceeded the limits intended by me when I commenced it, and I must reserve my remarks on the peculiar position of *Rynchonycteris naso* when resting on a perpendicular plane surface for another communication. G. E. DOBSON

[1] *Proc. Zool. Soc.*, 1862, p. 357.

[1] In a note to Sir James Emmerson Tennent's "Ceylon," Mr. Thwaites remarks :—"These bats (*Pteropus medius*) take possession during the day of particular trees, upon which they hang like so much ripe fruit."

Sense of Hearing in Birds and Insects

IN respect to "The Sense of Hearing in Birds," the habit of pattering with the feet while seeking food, which is common to many worm-eating birds, seems to preclude the idea that such birds at least depend to any great extent upon their powers of hearing. Gulls frequently tread or patter with their feet while seeking food. The object being clearly to discover, from some slight movement, the whereabouts of their hidden prey. Plovers, doubtless with the same object, vibrate one foot rapidly with tremulous motion on the ground. Now the plover is essentially a worm-catching bird, more so even, probably, than the thrush. Light-footed, active yet stealthy in its movements, quick-sighted, and certainly quick of hearing, the plover, when feeding, runs a little way, like the thrush, then stops, with head erect, looking intently; listening it might well be thought *but for the tremulous motion of its foot*. The plover, at such time, trusts without doubt to sight and not to its sense of hearing.

It is true that the thrush has not this trick of pattering with the foot. It is true also that it has, while seeking food, very much the look of listening attentively. The largeness of its eye and comparatively small development of its ear incline me, however, to believe with Mr. McLachlan (NATURE, vol. xv. p. 254), that the thrush also depends when feeding more on its power of sight than on its sense of hearing. C. J. A. MEYER

THE ATMOSPHERE OF THE ROCKY MOUNTAINS [2]

ANYONE who observes with a large telescope soon becomes aware of the great obstacle atmospheric undulation offers to the pursuit of astronomy, particularly in the application of photography and the spectroscope. During two years when I photographed the moon on every moonlight night at my observatory,[3] there were only three occasions on which the air was still enough to give good results, and even then there was unsteadiness. Out of 1,500 lunar negatives, only one or two were really fine pictures. A letter which the late Mr. Bond wrote to me states that in seventeen years he had never met with a perfectly faultless night at the Cambridge Observatory.

Such facts naturally cause astronomers to consider whether it is not possible to diminish atmospheric disturbances, and have led to the celebrated expeditions of Prof. Piazzi Smyth to the Peak of Teneriffe, and Mr. Lassell to Malta. Theoretically it would seem that the only complete solution is to ascend high mountain ranges or isolated peaks, and leave as much as possible of the air below the telescope.

Having had occasion during the months of August and September, 1876, to go on a hunting trip with two distinguished officers of the United States Army into the Rocky Mountains

[2] "Astronomical Observations on the Atmosphere of the Rocky Mountains, made at Elevations of from 4,500 to 11,000 feet, in Utah, Wyoming Territory and Colorado." By Henry Draper, M.D., Professor of Analytical Chemistry and Physiology in the University of New York. Communicated by the author.

[3] Prof. Henry Draper's observatory is at Hastings-on-Hudson, near New York; latitude 40° 59′ 25″, longitude 73° 52′ 25″; elevation above the sea, 22 feet.

and Wahsatch range, I thought it desirable to carry a telescope, with a view of ascertaining whether there would be sufficient inducement to return with my 12-inch achromatic or 28-inch reflector, and make a prolonged stay.

As it was not feasible to take an instrument of any great size, I contented myself with a small achromatic of unusual excellence. Though of only $1\frac{1}{4}$ inches aperture, it bears a power of 60 completely, and I think would carry 100. It was provided with a short brass tripod, holding an altitude and azimuth movement, giving both steadiness and smoothness of action. The eyepiece was capable of adjustment by a rack and pinion, and the object-glass was so arranged in its cell as to be free from injurious compression. This little lens stands the severe tests invented by Foucault, and in spite of its size is capable of doing good work.

In such observations on the atmosphere as those proposed during this trip, it is obvious that there are mainly two points to be considered: (1) freedom from tremor, and (2) transparency. A station combining both is most desirable, but a marked predominance of steadiness gives special advantages for celestial photography, while increase of transparency, even if accompanied by unsteadiness, is of value in eye observations. I had been led to suppose from conversations with Government officers and persons connected with the geological and geographical surveys of the territories, that the Wahsatch range, which is intermediate between the Sierra Nevada on the west and the true Rocky Mountains on the east, would offer the greatest advantages. This supposition turned out to be altogether incorrect, though it might have been argued that a high range flanked at a distance on either side by other higher ranges should have given the maximum chance for cloudless and still skies.

We first went to Salt Lake City, which, according to the Casella aneroid I carried, is at an elevation of 4,650 feet above the sea. It lies at the foot of the Wahsatch range. At eleven o'clock on the evening of arrival, August 25, I took some observations from the hotel after carefully centring the object-glass. Saturn looked about the same as on an ordinary night at my observatory. Capella, which was just clear of the house-tops across the street, twinkled as badly both to the naked eye and in the telescope as I have ever seen it at the sea-level. Lieut. Warren, of Camp Douglas [a military post near the city] said there had been a heavy rain the week previous, and the air was more moist than usual. The sun set among just such a bank of clouds as we are accustomed to see in New York. I was somewhat prepared for a tremulous condition in these high regions, because, the preceding night, having stopped for a few nights at Fort Steele, on the Union Pacific Railroad, I perceived that Antares twinkled very much, though we were nearly 7,000 feet above the sea.

However, in order to make a thorough trial it seemed best to ascend one of the high peaks of the Wahsatch, and accordingly the Red Butte was selected. The peak proved to be 7,350 feet high. Though it was quite clear when we started, clouds gathered in every direction as the sun went down, and at nightfall the sky was entirely overcast. Moreover, the wind blew so strongly that it was necessary to retire over the brow of the mountain, and eventually we returned to Camp Douglas. At this point, 5,250 feet above the sea, and about 600 feet higher than Salt Lake City, the telescope was set up to take advantage of some breaks in the clouds, through which the moon, Antares, ζ Ursæ Majoris, and Jupiter appeared. With a power of only twenty the twinkling was surprisingly great; I do not remember ever to have seen it worse with my large instruments.

These results led to an examination into the meteorology of Salt Lake City, so as to find out the rainfall and its distribution and the percentage of cloudy days.

It appears that the average annual rainfall for the past five years is $18\frac{40}{100}$ inches. There is no perfectly dry month, the nearest approach being during the summer. The cloudy dry days are 194 per annum, the disposition being similar to the rainfall.

A former pupil of mine, and graduate of the University, Dr. Benedict, informed me the Mormons believed the rainfall had much increased since their community had settled in Utah, and this seems to be borne out by the statement that whereas formerly three gallons of Salt Lake water produced on evaporation one gallon of salt, it now takes four gallons to produce the same quantity.

For these reasons it is doubtful whether there would be enough advantage in bringing a large telescope to this region to make it worth while to encounter the labour and expense.

On August 30, having taken an escort, we moved south from Fort Steele, latitude 41° 48′, longitude 107° 09′, along the North fork of the Platte River, into the main range of the Rocky Mountains. During the fifteen days' expedition there were only two nights on which we saw clouds enough to prevent astronomical working, and only one thunderstorm of any moment took place in our immediate vicinity; about one quarter of an inch of rain fell. The sky was rarely perfectly free from clouds, and many local thunderstorms occurred about the higher peaks, but they seldom extended to the plateaus below.

September 1 and 2 our camp was 8,900 feet above the sea in the vicinity of mountains rising 10,000 and 11,000 feet. These peaks seemed to be nearer than they really were, for the transparency of the air causes estimates of distance to be deceptive. From the top of one I subsequently saw the Seminole Mountain, which was 150 miles distant; it did not appear to be fifty miles away. The night of September 1 was quite clear, with very little cloud, and the atmosphere remarkably tranquil. Antares, when near setting, hardly twinkled at all, and Arcturus in the telescope, exhibited four diffraction rings unbroken by flickering. The central disc was as hard and sharply defined as the pin-hole in the lamp-screen I am accustomed to use in testing specula and lenses. I looked for the companion of Polaris, but partly on account of the nearly full moon, and partly from the thickness of the diffraction-rings, I could not be sure of it. The moon was perfectly steady; with a power of sixty there was no trace of twinkling at the terminator. I tried to see Titan, the largest satellite of Saturn, but did not succeed. At the time it was not certain whether this failure was due to the position of Titan with relation to Saturn, or whether it arose from the blinding effulgence of the moon. Capella was perfectly steady, though there was a slow change of colour from bluish to reddish, occupying about a second.

The succeeding night, at nine o'clock, though the sky was mostly covered with cumulus clouds in motion southward, I was astonished to find the terminator of the moon absolutely free from twinkling and Arcturus down among the tops of the dead aspen trees as steady as possible. The four diffraction rings round the central disc were not perfectly circular, but that was the fault of the lens. Every defect of centring or of surface and any vein in the glass comes out even more clearly than in the workshop examinations, because, while the air is as steady, the light is far more intense.

I am certain, if a large telescope could be brought here and maintained against the furious winds, great results might be attained if there is much of this weather. But this particular place is difficult of access, and possibly no better than other situations on the line of the railroad. The sky is not as black as I had expected; it is rather of a light blue, though the full moon makes much difference.

On several other nights, in both lower and higher places, I made observations, but never saw the combination of steadiness and transparency again. On the plateaus at the foot of the mountains and away from the groves of quaking aspen trees and pines, the sun sends down scorching rays all day long on the alkali plains, where only sage plants are sparsely scattered, and even on horseback one can see the heated waves rising from the ground. The air is far from being moist, for the lips are apt to crack and bleed, and the mucous membrane of the nose is parched. When the sun sets the ground rapidly radiates, and we frequently had by morning one quarter of an inch of ice in our vessels of water standing outside the tents. These plateaus are on an average about 7,250 feet above the sea. The mere fact of broken ground and wooded surroundings does not, however, suffice to produce, even at this season, a tranquil air; for when we rode over the Rocky Mountains, along the margin of perpetual snow, to the head-waters of Snake River, and camped at Trout Lake, nearly 10,000 feet high, though the air was exceedingly transparent, it was very unsteady. I rose at 4 A.M. to see Venus, and her splendour was so great that it led to a most delusive estimate of her apparent size. Occasionally, during clear frosty weather in midwinter, a night of similar characteristics is seen at my observatory. On such an occasion I obtained, at the principal focus of the $15\frac{1}{2}$-inch reflector, a photograph of the moon near her third quarter in less than a second.

The officers of Fort Steele and the guides say it would be impossible to do any astronomical work in this region from the middle of October till the middle of May, that is, for seven months. The fierce winds, heavy falls of snow, and intense cold would be unbearable. Even in the beginning of September

we needed large camp-fires in the morning and evening. Our camp at Trout Lake could only be reached for six weeks in summer on account of the depth of snow in the fallen timber.

On the whole, it may be remarked of this mountain region, that the astronomical condition, particularly for photographic researches, is unpromising. In only one place were steadiness and transparency combined, and only two nights out of fifteen at the best season of the year were exceptionally fine. The transparency was almost always much more marked than at the sea-level, but the tremulousness was as great, or even greater, than near New York. It is certain that during more than half the year no work of a delicate character could be done. At the end of August, in sheltered positions, and in good tents, we slept under half a dozen thicknesses of blanket, and only partially undressed. Such a degree of cold distracts the mind and numbs the body. Apparently, therefore, judging from present information, it would not be judicious to move a large telescope and physical observatory into these mountains with the hope of doing continuous work under the most favourable circumstances.

TESTIMONIAL TO MR. DARWIN

MR. DARWIN has received as a testimonial, on the occasion of his sixty-ninth birthday, an album, a magnificent folio, bound in velvet and silver, containing the photographs of 154 men of science in Germany. The list contains some of the best known and most highly honoured names in Europe. He has likewise received on the same occasion from Holland an album with the photographs of 217 distinguished professors and lovers of science in that country. These gifts are not only highly honourable to Mr. Darwin, but also to the senders as a proof of their generous sympathy with a foreigner; and they further show how widely the great principle of Evolution is now accepted by naturalists.

A German correspondent informs us that the German album bears on the handsome title-page the inscription "Dem Reformator der Naturgeschichte, Charles Darwin."

MICROSCOPICAL INVESTIGATION OF SANDS AND CLAYS[1]

THE anniversary address of the president, Mr. H. C. Sorby, F.R.S., at the Royal Microscopical Society on Wednesday, March 7, consisted mainly of an attempt to treat in a systematic manner the application of the microscope to the study of the mineral constituents of sands and clays. The various organisms found in such deposits have been much studied by Ehrenberg and other microscopists, and of late years much attention has been directed to the structure of igneous and other hard rocks, more or less allied to them, which can be cut into thin sections; but comparatively little attempt has been made to investigate the ultimate constitution of loose sands, muds, and clays.

The scope of this subject, as treated by the author, included the identification of the true mineral nature of the various particles, and the determination of the nature of the rock from which they were originally derived; the chief aim being to trace back the history of the material to the furthest possible extent.

After describing the manner in which the different kinds of deposits should be prepared, examined, and mounted as permanent objects, the author treated at some length on the conditions necessary for satisfactorily seeing the various particles with moderate or very high magnifying powers, and for observing their microscopic structure and optical characters. The particles of clay and the fluid-cavities in the grains of sand are often so minute as to task the power of the microscope to the fullest extent, and some indeed are so small that their perfect definition may perhaps be impossible by any means at our command. It was shown that the conditions under which many of the objects are visible are such that with highly convergent light and object-glasses of large aperture no dark outline is possible, and therefore they are quite invisible, but become quite distinct when the aperture is reduced to a moderate and appropriate amount. For this reason object-glasses of comparatively small aperture are far the best, since the focal point being further from the front lens, very high powers can be used in cases which are beyond the reach of lenses of large aperture.

The author then went into much detail to show the character of the grains of quartz, mica, and other minerals derived from the decomposition or breaking up of various crystalline rocks, and showed that on the whole there are many characteristic differences between the material derived from granitic and schistose rocks—this difference consisting mainly in the form, internal structure, and optical characters of the various constituent grains; the general conclusion being that a careful study of sands, muds, and clays enables us to form a very satisfactory opinion as to whether they were derived mainly from granitic or schistose rocks, or from a mixture of the two in some approximately definite proportion. It was also shown that the shape of the particles as originally derived from their parent rock is sufficiently definite and characteristic to enable us to form a very good opinion respecting the amount of subsequent mechanical or other change.

Applying those principles to the study of particular typical cases, it was shown that the coarser grained British sandstones have been mainly derived from granite rocks, of a character somewhat intermediate between those of the Scotch Highlands and Scandinavia. Some of these sandstones consist of grains which have undergone scarcely any wearing, and are as angular as those derived directly from decomposed granite, and are thus totally unlike the blown sand of the deserts, which are worn into perfectly rounded grains.

The finer grained sands are no less angular than the coarse, and have not been derived from the wearing down of larger fragments, but have resulted from the separation of the small from the large grains by the action of currents. Though some fine-grained sand-stones have been mainly derived from granitic rocks, yet, on the whole, the small particles of quartz have more commonly been derived from the breaking up of schistose rocks. Clays and shales consist to a great extent of particles identical in all their characters with those derived from the decomposition of felspars and other minerals which undergo a similar change. As a general rule we meet with many grains of sand even in clays chiefly consisting of extremely minute granules, which can easily be explained by the remarkable manner in which such material, when suspended in water, collects into small compound grains, which subside at a rate quite independent of what would be the velocity of subsidence of the separate particles if they were detached.

The conclusions derived from a study of the characters of the separate grains are confirmed by the occurrence of what may be truly considered to be grains of granite or mica schist. We also in some cases meet with grains sufficiently large to show the characteristic structure of the still more complex rocks of which they are composed. Thin sections of some of the oldest slates in Wales are thus as it were a perfect museum of specimens of the rocks existing at a still earlier period, broken up and worn down into the sands which formed these very ancient slates.

In order to establish these various conclusions it would be necessary to enter into a large amount of detail, but perhaps what has been said may suffice to indicate the general line of inquiry, and to show that by making full use of every microscopic means, it is possible to learn many important facts from such very unpromising materials as sands and clays.

[1] Abstract by the author.

REMARKABLE PLANTS [1]

II.—Some Curious Orchids.

1. *General Structure of the Flower of Orchids.*—The exotic representatives of the natural order Orchideæ have long been favourite objects of cultivation in our hot-houses, from the beautiful and often bizarre form assumed by their curious flowers. Great as is the variety in the size, colour, and form of the flower in the different genera, it is, nevertheless, more than in most natural orders, constructed always on one plan in its main features. Before describing some of the more remarkable forms, it will be necessary to give a general description of this type, and to define the more important of the technical terms used by botanists in relation to it. Both in this account and in the description which follows of particular species, we are largely indebted to Mr. Darwin's most interesting work [2] on orchids, of which a new edition has just appeared; the illustrations are also reproduced, by the kindness of the publisher, from the same work.

In all orchids the number of sepals and petals (which together form the perianth) is three each, the former being almost always nearly or quite as brightly coloured as the latter. One of the petals—really the upper one, but, in consequence of the twisting of the ovary, apparently the lower one—is nearly always larger than the others, and is so situated as to form a convenient stage for insects to settle on. It is called the lower lip or *labellum* (Fig. 1, *l*.), and often assumes the most singular and fantastic shapes. It secretes nectar or honey, which is often contained in a longer or shorter spur-shaped prolongation or nectary (*n*) at its back, but sometimes in the tissue itself, which is then commonly gnawed by insects. There is only one fertile stamen (rarely two), which is confluent with the stigma, and forms with it the *column*. The anther (*a*) consists of two cells, which are usually very distinct, and often so widely separated as to appear like two anthers. The pollen is not, in most orchids, in the form of a fine granular powder, but coherent into two club-shaped masses, the pollen-masses or *pollinia* (*p*), one contained in each anther-cell; these are prolonged below into a kind of stalk termed the *caudicle* (*c*). The ovary is inferior (beneath the calyx), often presenting the appearance of a stalk to the flower, and consists of three carpels closely united together into a single cavity. The single stigma (*s*) is sessile upon the ovary, and is confluent with the stamen (*gynandrous*). Its upper part is modified into an extraordinary organ called the *rostellum* (*r*), which, when mature, consists partly or entirely of viscid matter. In many species the pollinia are firmly attached to a portion of the exterior membrane of the stigma, which, when insects visit the flower, is removed, together with the pollinia. This removable portion of the rostellum is called the *viscid disc* (*d*), or by some authors the "gland" or "retinaculum"; when large, the portion to which the pollinia is attached is called the *pedicel* (often confounded with the caudicle). The part of the rostellum which is left after the removal of the disc and viscid matter is called the *fovea*, or sometimes the "pouch" or "bursicula." In the present paper we propose to give an account of a few orchids, interesting from the remarkable mode in which fertilisation by insects is effected.

2. *Coryanthes macrantha.*—The genus *Coryanthes* belongs to the tribe Vandeæ, which includes many of the most magnificent extra-British orchids. The extraordinary mode of fertilisation is certified by Dr. Crüger, director of the Botanic Gardens at Trinidad. The accompanying figure (Fig. 2) represents the flower of *C. speciosa*, an allied species, but will serve to show the relative position of the parts. It is very large, and hangs downwards. The lower portion of the labellum (L) is converted into a kind of bucket (B). Two short appendages (H), which arise from the narrowed base of the labellum, stand directly over this bucket, and secrete so much limpid and slightly sweet fluid that it drops into the bucket; the quantity secreted by a single flower is said to be about an ounce, but it does not appear to attract insects. When the bucket is full, this fluid overflows at a channel which forms a kind of spout (P), closely over-arched by the end of the column, which bears the stigma and pollinia in such a position that an insect, forcing its way out of the bucket through this passage, would first brush with its back against the stigma, and afterwards against the viscid discs of the pollinia, and thus remove them. In *C. macrantha* the labellum is,

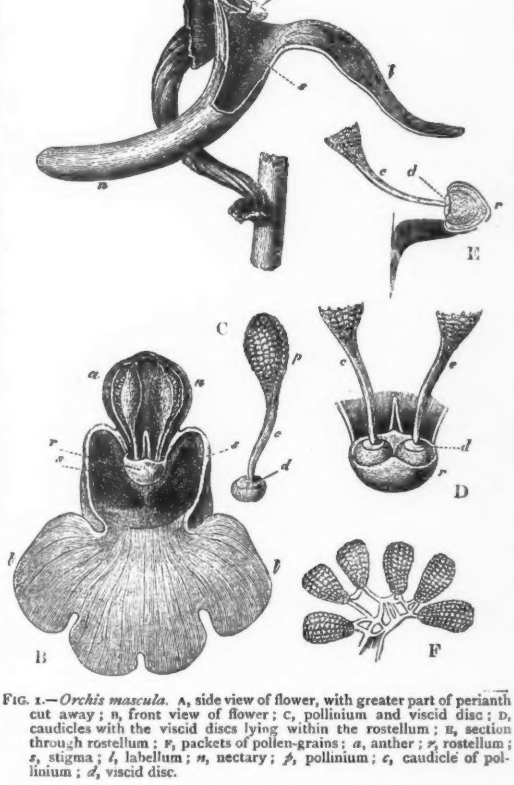


Fig. 1.—*Orchis mascula.* A, side view of flower, with greater part of perianth cut away; B, front view of flower; C, pollinium and viscid disc; D, caudicles with the viscid discs lying within the rostellum; E, section through rostellum; F, packets of pollen-grains; *a*, anther; *r*, rostellum; *s*, stigma; *l*, labellum; *n*, nectary; *p*, pollinium; *c*, caudicle of pollinium; *d*, viscid disc.

according to Dr. Crüger,[1] provided with crests, which are gnawed by bees, as is commonly the case with the labellum of the Vandeæ. In this case the bees have been determined by Mr. F. Smith, of the British Museum, to belong to the genus *Euglossa*. Dr. Crüger states that these bees may be seen in great numbers disputing with each other for a place on the edge of the "hypochil" or basal part of the labellum. Partly by this contest, partly, perhaps, intoxicated by their food, they fall into the bucket, which is half full of the fluid already mentioned. They then crawl along in the water towards the anterior side of the bucket, where they arrive at the spout. But, in order to extricate itself through this opening, the bee has to use considerable exertion, as the mouth of the

[1] Continued from p. 299.

[2] "The Various Contrivances by which Orchids are Fertilised by Insects." By Charles Darwin, M.A., F.R.S., &c., Second Edition, revised, with Illustrations. (London: J. Murray, 1877.)

[1] *Journal of Linnean Society*, Botany, vol. viii., 1864, p. 130.

"epichil," or upper part of the labellum, fits closely to the column and is very stiff and elastic. The first bee which is immersed will have the pollinia glued to its back by their viscid disc. Having escaped through the passage with this appendage, the insect then returns nearly immediately to its feast, when it is generally precipitated a second time into the bucket, passes out through the same opening, and thus inserts the pollinia into the stigma as it forces its way out, thereby impregnating either the same or some other flowers. Dr. Crüger states that he has seen so many of the bees taking part in this operation that there is a continual procession of them through the passage. "There cannot be the least doubt," says Mr. Darwin, "that the fertilisation of the flower absolutely depends on insects crawling out through the passage formed by the extremity of the labellum and the over-

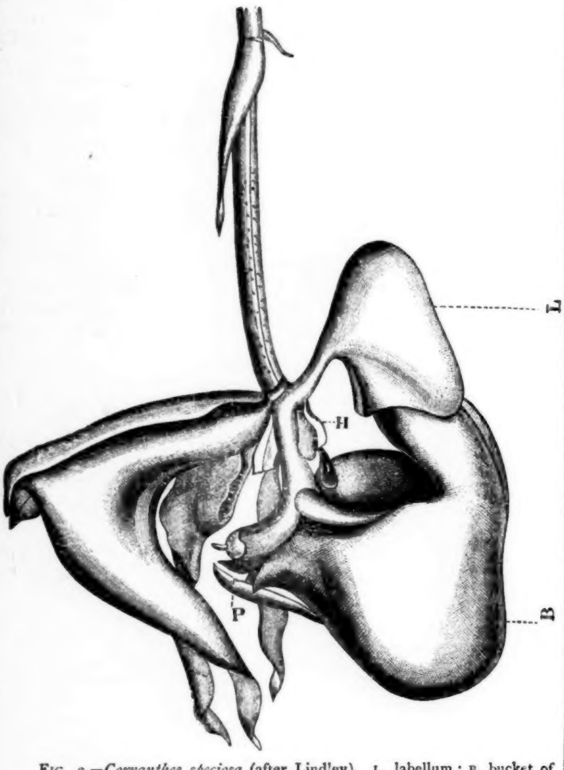


FIG. 2.—*Coryanthes speciosa* (after Lindley). L, labellum; B, bucket of labellum; H, fluid-secreting appendages; P, spout of bucket, over-arched by the end of the column bearing the anther and stigma.

arching column. If the large distal portion of the labellum or bucket had been dry the bees could easily have escaped by flying away. Therefore we must believe that the fluid is secreted by the appendages in such extraordinary quantity, and is collected in by the bucket, not as a palatable attraction for the bees, as these are known to gnaw the labellum, but for the sake of wetting their wings and thus compelling them to crawl out through the passage."

3. *Catasetum saccatum.*—The genus *Catasetum* belongs also to the sub-order Vandeæ, and to a section of that order, the Catasetidæ, distinguished from all other orchids by several very remarkable peculiarities. In the first place it stands almost alone among all genera of orchids in having unisexual flowers; and so greatly do the male and female flowers—which are usually borne on different plants—differ from one another, that they were long regarded as belonging to different species, or even genera; while, to complicate the matter still further, some kinds have a third hermaphrodite form differing greatly from either of the others. Thus *Catasetum tridentatum* (male), *Monachanthus viridis* (female), and *Myanthus barbatus* (hermaphrodite), are now known to be three forms of the same species. The second peculiarity of the male flowers of *Catasetum* is that they are provided with an extraordinary mechanical contrivance by means of which the pollinia are forcibly ejected on to the back of the insect, and thus carried to a female flower of the same species. There is no nectar in the male flower to attract insects; the ejection of the pollinia results from the accidental

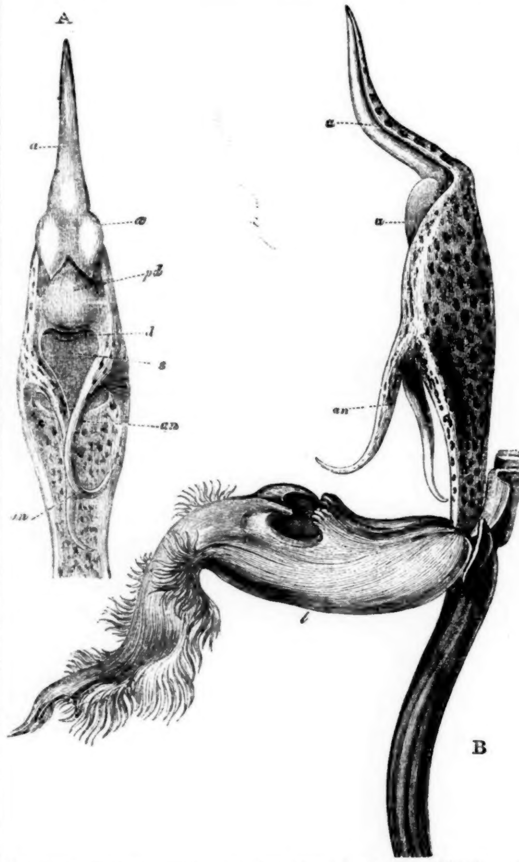


FIG. 3.—*Catasetum saccatum*. A, front view of column; B, side view of flower, with all the perianth except the labellum removed; *a*, anther; *an*, antennæ; *d*, viscid disc; *l*, labellum; *pd*, pedicel of pollinium; *s*, stigmatic chamber.

touching, by the wing of a passing insect or of one seated on the labellum for the purpose of gnawing it, of two long horns or *antennæ*, which occur in no other genus, and are placed in such a position that when touched by the insect the pollinia are projected on to its body, to which they adhere by their blunt and excessively adhesive point. The insect then flies away to a female plant, and while standing in the same position as before on the flower, the pollen-bearing end of the pollinia is inserted into the stigmatic cavity, and a mass of pollen left on its viscid disc. Mr. Darwin has examined five species of *Catasetum*, and finds that this is the only possible way in which they can be fertilised.

In the accompanying Fig. 3 (A being a front, B a side

view of a flower, from which all the perianth except the labellum has been removed), *a* represents the anther containing the pollinia, and prolonged above into a long point, *an* the antennæ, which are rigid, curved, hollow horns tapering to a point; but the two differ from one another in this respect, that the apex of the left-hand one bends upwards, while the right-hand one hangs down, and is apparently almost always paralysed and functionless; *l* is the labellum; *d* the disc of the pollinium, which is remarkably large and viscid; *pd* the pedicel of the pollinium; *s* the stigmatic chamber, which is of course functionless in the male flower. The action of the parts is thus described by Mr. Darwin:—When the left-hand antenna is touched, the edges of the upper membrane of the disc, which are continuously united with the surrounding surface, instantly rupture, and the disc is set free. The highly elastic pedicel then instantly flirts the heavy disc out of the stigmatic chamber with such force that the whole pollinium is ejected, bringing away with it the two balls of pollen, and tearing the loosely-attached spike-like anther from the top of the column. The pollinium is always ejected with its viscid disc foremost, and with such force that it is thrown to a distance of two or

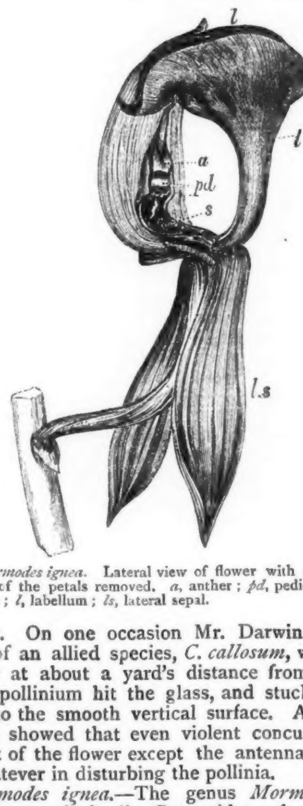


FIG. 4.—*Mormodes ignea.* Lateral view of flower with one of the sepals and one of the petals removed. *a*, anther; *pd*, pedicel of pollinium; *s*, stigma; *l*, labellum; *ls*, lateral sepal.

three feet. On one occasion Mr. Darwin touched the antenna of an allied species, *C. callosum*, while holding the flower at about a yard's distance from the window, when the pollinium hit the glass, and stuck by its adhesive disc to the smooth vertical surface. A series of experiments showed that even violent concussion of any other part of the flower except the antenna produced no effect whatever in disturbing the pollinia.

4. *Mormodes ignea.*—The genus *Mormodes* belongs also to the small family Catasetidæ; the pollinia are again violently ejected, as in *Catasetum;* but the mode in which this is effected is somewhat different, and very curious. The appearance presented by the flower is represented in Fig. 4. The base of the column is bent backwards, at right angles to the ovary, then resumes an upright position, and is finally again bent near the summit. It is also twisted so that the anther, rostellum, and the upper part of the stigma face one side of the flower, to the right or left, according to the position of the flower in the spike. In the drawing, *a* represents the anther, which is elongated and triangular, but does not extend to the apex of the column. A group of spiral vessels runs up the column as far as the summit of the anther; they are then reflexed, and run some way down the anther-case. The point of reflexion forms a short thin hinge, by which the top of the anther-case is articulated to the column beneath its bent surface; and this hinge appears to be the sensitive portion of the structure, conveying any stimulus from a touch to the disc of the pollinia, and causing the ejection of the latter. *pd* is the pedicel of the pollinium, covering the rostellum; *st*, the stigmatic surface, which extends down to the base of the column, and is hollowed out into a deep cavity at its upper end; *l* is the very remarkable labellum, narrowed at the base into a nearly cylindrical foot-stalk, and its sides so much reflexed as almost to meet at the back, forming a folded crest at the summit of the flower. Near the summit it has a slight cavity, into which the summit of the column fits, fixing it in its place. The whole labellum is compared by Mr. Darwin to a cocked hat supported by a foot-stalk, and placed on the head of the column. *ls* are the two lower sepals, which hang down like wings; the upper sepal and one of the lateral petals have been cut off. By a number of experiments Mr. Darwin found that the minute hinge in the anther-case already described is the only portion of the flower that is sensitive to touch. When an insect lights on the folded crest of the labellum, the only convenient landing-place, he will lean over the front of the column in order to gnaw or suck the bases of the petals, which are filled with a sweet fluid. In so doing, he will disturb the summit of the column which fits into the cavity of the labellum; this will press on the hinge in the anther-case; the stimulus will then be conveyed to the pollinium-disc, and the pollinium will be violently ejected. Owing to the peculiar structure of the parts, guided by the hinge, which now serves a second function, the direction in which the pollinium flies is necessarily vertically upwards. If no object is in the way, it is projected perpendicularly up in the air, an inch or two above and close in front of the terminal part of the labellum, and would then alight on the folded crest of the labellum immediately above the column. But if the insect which has caused the disturbance remains in the same position, the pollinium will necessarily alight on his head, and will thus be carried off to fertilise another flower. The pollinium has, however, still the anther-cap attached to it; this drops off, as the pedicel dries on exposure to the air and gradually straightens itself from the almost hoop-shaped form which it bore when ejected; and when this has been done, the pollen-masses attached to the head of the insect are precisely in a position to strike against the stigmatic surface of the next flower visited.

Other instances, almost as extraordinary, could be cited of the special contrivances met with in species belonging to this order, to insure cross-fertilisation rather than self-fertilisation of the flowers. A. W. B.

THE MOVEMENT OF THE SOIL-CAP

AMID all their general tameness the Falkland Islands boast one natural phenomenon which is certainly exceptional, and at the same time very effective.

In the East Island most of the valleys are occupied by pale-grey glistening masses, from a few hundred yards to a mile or so in width, which look at a distance much like glaciers descending apparently from the adjacent ridges, and gradually increasing in volume, fed by tributary streams, until they reach the sea. Examined a little more closely, these are found to be vast accumulations of blocks of quartzite, irregular in form, but having a tendency to a rude diamond shape, from two to eight or ten or twenty feet long, and perhaps half as much in width, and of a thickness corresponding with that of the quartzite bands

in the ridges above. The blocks are angular, like the fragments in a breccia, and they rest irregularly one upon the other, supported in all positions by the angles and edges of those beneath.

They are not weathered to any extent, though the edges and points are in most cases slightly rounded; and the surface, also perceptibly worn, but only by the action of the atmosphere, is smooth and polished; and a very thin, extremely hard, white lichen, which spreads over nearly the whole of them, gives them the effect of being covered with a thin layer of ice.

Far down below, under the stones, one can hear the stream of water gurgling which occupies the axis of the valley; and here and there, where a space between the blocks is unusually large and clear, a quivering reflection is sent back from a stray sunbeam.

At the mouth of the valley the section of the "stone river" exposed by the sea is like that of a stone drain on a huge scale, the stream running in a channel arched over by loose stone blocks, or finding its way through the spaces among them. There is scarcely any higher vegetation on the "stone river;" the surface of every block is slippery and clear, except where here and there a little peaty soil has lodged in a cranny, and you find a few trailing spikes of *Nassauvia serpens*, or a few heads of the graceful drooping chrysanthemum-like *Chabræa suaveolens*.

These "stone-rivers" are looked upon with great wonder by the shifting population of the Falklands, and they are shown to visitors with many strange speculations as to their mode of formation. Their origin seems, however, to be obvious and simple enough, and on that account their study is all the more instructive; for they form an extreme case of a phenomenon which is of wide occurrence, and whose consequences are, I believe, very much underrated.

There can be no doubt that the blocks of quartzite in the valleys are derived from the bands of quartzite in the ridges above, for they correspond with them in every respect; the difficulty is to account for their flowing down the valley, for the slope from the ridge to the valley is often not more than six to eight degrees, and the slope of the valley itself only two or three, in either case much too low to cause blocks of that form either to slide or to roll down.

The process appears to be this. The beds of quartzite are of very different hardness; some are soft, passing into a crumbling sandstone; while others are so hard as to yield but little to ordinary weathering. The softer bands are worn away in process of time, and the compact quartzites are left as long projecting ridges along the crests and flanks of the hill-ranges. When the process of the disintegration of the softer layers has gone on for some time the support of their adjacent beds is taken away from the denuded quartzites, and they give way in the direction of the joints, and the fragments fall over upon the gentle slope of the hillside. The vegetation soon covers the fallen fragments and usually near the sloping outcross of the hard quartz, a slight inequality only in the surface of the turf indicates that the loose blocks are embedded beneath it. Once embedded in the vegetable soil a number of causes tend to make the whole soil-cap, heavy blocks included, creep down even the least slope. I will only mention one or two of these. There is constant contraction and expansion of the spongy vegetable mass going on, as it is saturated with water or comparatively dry; and while with the expansion the blocks slip infinitesimally down, the subsequent contraction cannot pull them up against their weight; the rain-water trickling down the slope is removing every movable particle from before them; the vegetable matter on which they are immediately resting is undergoing a perpetual process of interstitial decay and removal. In this way the blocks are gradually borne down the slope in the soil-cap and piled in the valley below. The only other question is how the soil is afterwards removed and the blocks left bare. This, I have no doubt, is effected by the stream in the valley altering its course from time to time, and washing away the soil from beneath.

This is a process which, in some of the great "stone-rivers" in the Falkland Islands, must have taken an enormous length of time. I fear that the extreme glacialists will see in it a danger to the universal application of their beloved theory to all cases of scratching and grooving. I have known too much of the action of ice to have the slightest doubt of its power; but I say that ice had no hand whatever in the production of these grand "moraines" in the Falkland Islands.

In the West Highlands of Scotland, and in many other parts of the world, I have often noticed that when a hill of such a rock as clay-slate comes down with a gentle slope, the outcrop of the vertical or highly-inclined slates covered with a thick layer of vegetable soil or drift containing imbedded blocks and boulders derived from higher levels, the slates are frequently first slightly bent downwards, then abruptly curved and broken, and frequently the lines of the fragments of the fractured beds of slate can be traced for a yard or two in the soil-cap, gradually becoming parallel with its surface, and passing down in the direction of its line of descent. These movements are probably extremely slow. I well remember many years ago observing a case, somewhere in the west of Scotland, where a stream had exposed a fine section of the soil-cap with the lines of broken-down and crushed slate-beds carried far down the slope. The whole effect was so graphically one of vigorous and irresistible movement that I examined carefully some cottages and old trees in hope of finding some evidence of twisting or other irregular dislocation, but there appeared to be none such. The movement, if it were sufficiently rapid to make a sign during the life-time of a cottage or a tree, evidently pervaded the whole mass uniformly.

It seems to me almost self-evident that wherever there is a slope, be it ever so gentle, the soil-cap must be in motion, be the motion ever so slow; and that it is dragging over the surface of the rock beneath the blocks and boulders which may be embedded in it, and frequently piling these in moraine-like masses, where the progress of the earth-glacier is partially arrested, as at the contracted mouth of a valley, when the water percolating through among them in time removes the intervening soil. As the avalanche is the catastrophe of ice-movement, so the land-slip is the catastrophe of the movement of the soil-cap.

As I have already said, I should be the last to undervalue the action of ice, or to doubt the abundant evidences of glacial action; but of this I feel convinced, that too little attention has been hitherto given to this parallel series of phenomena, which in many cases it will be found very difficult to discriminate; and that these phenomena must be carefully distinguished and eliminated before we can fully accept the grooving of rocks and the accumulation of moraines as complete evidence of a former existence of glacial conditions.

C. WYVILLE THOMSON

ON THE INFLUENCE OF GEOLOGICAL CHANGES ON THE EARTH'S AXIS OF ROTATION[1]

THE subject of the fixity or mobility of the earth's axis of rotation in that body, and the possibility of variations in the obliquity of the ecliptic has of late been attracting much attention. Sir W. Thomson referred shortly to it in his address at Glasgow last September,

[1] An account of a paper by G. H. Darwin, M A., read before the Royal Society on November 23, 1876.

and Dr. Jules Carret has just published an ingenious book on the subject.[1]

The paper, of which the following is an abstract, is an attempt to investigate the results of the supposition that the earth is slowly changing its shape from internal causes. The first part is devoted to the mathematical consideration of the precession and nutations of a spheroid slowly undergoing such a change. It is shown that the obliquity of the ecliptic must have remained sensibly constant throughout geological history, and that even gigantic polar icecaps cannot have altered the position of the Arctic circle by so much as three inches; and this would be the most favourable redistribution of matter for producing that effect.

But a slow distortion of the earth would displace the principal axis of figure of the earth, and the axis of rotation would always sensibly follow the axis of figure. Thus the result would be a change in the geographical position of the poles, without any alteration of the diameters of the arctic circles, or in the width of the tropics.

For reasons, which cannot be given here, it is maintained that the earth would not be rigid enough to resist the effects of considerable departures from the figure of equilibrium, such as would arise from a wandering of the pole of figure from its initial position; and that readjustments to an approximate form of equilibrium would probably take place, at considerable intervals of time, impulsively by means of earthquakes. Such periodical adjustments would not sensibly modify the geographical path of the principal axis as due to terrestrial deformation.

The rest of the paper is given to the consideration of the kinematical question of the change in the geographical position of the pole, due to any distortion of the earth. It is assumed, in the first place, that the deformation is such that there is no change in the strata of equal density; and accordingly all suppositions as to the nature of the internal changes accompanying geological upheaval and subsidence are set aside. The forms of continents and depressions are investigated, which would cause the maximum deflection of the pole for elevations and depressions of given amounts.

In order to make numerical application to the case of the earth, some estimate is required of the extent to which it may have become distorted during any one geological period. From the consideration of certain facts, the author believes that from $\frac{1}{10}$ to $\frac{1}{20}$ of the whole earth's surface may have, from time to time, undergone a consentaneous rise or fall; and that the vertical rise or fall may be about 10,000 feet, or rather equivalent to about 10,000 feet, when allowance is made for the influx of the sea into depressed areas.

The first application given in this paper is to continents and seas of the most favourable shapes and positions. It may be here stated that if $\frac{1}{200}$ of the earth's surface is elevated by 10,000 feet, the deflection of the pole is $11\frac{1}{3}'$; if $\frac{1}{20}$ of the whole surface, $1^\circ\ 46\frac{1}{2}'$; if $\frac{1}{10}$, $3^\circ\ 17'$; and if $\frac{1}{2}$, $8^\circ\ 4\frac{1}{2}'$.[2] In each case an equal area is supposed to fall simultaneously.

Other examples are also given for continents and seas which do not satisfy the maximum condition; in some the boundaries are abrupt cliffs, in others shelving.

The conclusion is arrived at that a single large geological change, such as those which obtain on the earth, is competent to produce an alteration in the position of the pole of *from one to three degrees of latitude*, on the hypothesis that there is no change in the law of internal density.

Various other hypotheses as to the nature of the internal changes accompanying the deformation of the earth are discussed.

1. It is shown that if upheaval and subsidence are due to a shrinking of the earth as a whole, but to the shrinking being quicker than the mean in some regions and slower in others, the results are the same as those previously attained.

2. The increase of surface-matter due to the deposit of marine strata also gives the same results.

3. The hypothesis that upheaval and subsidence are due to intumescence or contraction immediately under the regions in question is considered. Under certain special assumptions, too long to recapitulate, it is shown that the previous results must be largely reduced. It appears that if the swelling or contracting stratum is tolerably thin and at all near the surface, the deflection of the pole is reduced to quite an insignificant amount. Even if the intumescence extends right down to the centre of the earth in a cone bounded by the elevated region, the results would be only about $\frac{2}{3}$ of the former ones. Hence it appears that the earlier results can only be stated as the greatest possible for given superficial changes.

In conclusion it is pointed out that if the earth be quite rigid, no redistribution of matter in new continents could ever cause the deviation of the pole from its primitive position to exceed the limit of about 3°. But if the previously maintained view is correct, that the earth readjusts itself periodically to a new form of equilibrium, then there is a possibility of a cumulative effect; and the pole may have wandered some 10° or 15° from its primitive position, or have made a smaller excursion and returned to near its old place. No such cumulation is possible, however, with respect to the obliquity of the ecliptic.

It is suggested that possibly the glacial period may not have been really one of great cold, but that Europe and North America may have been then in a much higher latitude, and that on the pole retreating they were brought back again to the warmth. There seem to be, however, certain geological objections to this view.

[1] "Le Déplacement Polaire." Savy, Paris, 1877.

[2] The area of Africa is about ·059, and of South America about ·033 of the earth's surface.

THE NEW STAR IN CYGNUS[1]

ON January 9 the sky was unusually clear and the spectrum of Dr. Schmidt's Nova came out with amazing sharpness and brilliancy. In addition to the five bright lines seen on the 2nd, two others were detected, viz.:—

		Mill.mm.	
No. 1a	W. L.	594	Very narrow line.
„ 7	„	414±	Excessively faint, but still certainly and repeatedly seen.

Between wave-lengths 655 and 594 the spectrum was certainly banded, and, most probably, there were two additional faint maxima of brilliancy in that interval. The continuous spectrum attains a maximum in the region about W. L. 525, and extends, though possibly not without interruption, as far as the faint line No. 7. The star was estimated of seventh magnitude, and was of a red colour with a decided tinge of purple, reminding me forcibly of the varieties of red produced by the quartz-plate in Zöllner's photometer. RALPH COPELAND

Lord Lindsay's Observatory, Dunecht, January 13

OUR ASTRONOMICAL COLUMN

THE NEW COMET.—The comet discovered by M. Borrelly, at Marseilles, on the morning of February 9, appears to have been found independently by Herr Pechüle at the Observatory of Copenhagen on the following morning. During the past week it has been making a pretty near approach to the earth, and had the weather been more favourable in Europe, it would probably have been very generally observed.

The following elements of the orbit have been calculated by Mr. Hind from the first observation by M. Borrell , one at

[1] *Astronomische Nachrichten*, No. 2,117.

Kiel on the 10th, and one made at the Imperial Observatory at Strasburg on the 15th, and communicated by Prof. Winnecke:—

Perihelion Passage, January 19·18017, Greenwich M.T.

	° ′ ″	
Longitude of the perihelion ...	200 5 2	Apparent
„ „ ascending node	187 14 22	Equinox, Feb. 10.
Inclination to the ecliptic ...	27 5 13	
Logarithm of perihelion distance	9·907086	

Heliocentric motion—retrograde.

According to this orbit the comet was distant from the earth, at the time of discovery, 0·45, the earth's mean distance from the sun being taken as unity. Its apparent path in the heavens about the perigee, and up to March 6, will be sufficiently defined by the following ephemeris:—

For Greenwich Midnight.

	Right Ascension. ° ′	North Polar Distance. ° ′	Distance from the Earth.
February 13......	262 50	70 22	0·324
15......	266 21	57 2	0·292
17......	272 10	41 42	0·279
19......	283 10	26 48	0·288
21......	307 40	15 35	0·318
23......	359 21	11 52	0·363
25......	27 41	15 9	0·418
27......	42 51	19 43	0·479
March 6......	58 51	31 1	0·719

From the above figures it will be seen that the diurnal motion, about the middle of the present month, amounted to 8° in arc of great circle; the comet was nearest to the earth soon after midnight on the 17th. At the time of perihelion passage it would be situated about 6° to the east of Antares, distant from the earth 1·15.

There is a certain similarity, but by no means a striking one, between the elements of this comet and those of the comet of 1590, observed by Tycho Brahé, the orbit of which was first calculated by Halley, and, in 1846, after a new reduction of Tycho's observations, by Mr. Hind (*Ast. Nach.*, No. 584). It may be worthy of remark that shortly after the passage of the ascending node, the comet of 1590 approaches very near to the orbit of the planet Venus, the least distance not exceeding 0·04. Still the differences between the elements of the comets of 1590 and 1877, especially in the perihelion distance, are material.

THE "BERLINER ASTRONOMISCHES JAHRBUCH."—Under the active superintendence of Prof. Tietjen, the *Berliner Jahrbuch* continues the heavy labour involved in the preparation of ephemerides of the extensive group of small planets, a work which for many years past has been made its specialty. In the volume for 1879 now before us, we have the places for 1877 of 151 out of the 172 actually known members of the group, No. 164, Eva, being the latest discovery included in the list. Also the elements of their orbits and the opposition magnitudes, a very useful addition towards the identification of these minute bodies amongst the fainter stars. The portion of the volume devoted to the small planets extends to 106 pages. The judicious transfer of the ephemeris of the moon, derived from Hansen's Tables from our *Nautical Almanac*, which appears between one and two years earlier, to the pages of the *Berliner Jahrbuch*, after adaptation to the meridian of Berlin, whereby a most serious expenditure of time and labour is saved, has already been noted in this column; it is a step which no doubt assists materially in completing the peculiar work of the *Jahrbuch*.

The following are names which have been recently proposed, for discoveries made within the last few years: No. 139 *Juewa*, 149 *Medusa*, 150 *Nuwa*, 155 *Scylla*, 160 *Una*, 161 *Athor*, 163 *Erigone*, 164 *Eva*. No. 162 is not yet named.

Only four of these planets (in addition to two of the old members) attain 8·5m. or upwards at their oppositions in 1877. Ariadne, in opposition on July 24, approaches the earth within about 0·84 of the earth's mean distance from the sun, and Iris, which at her opposition on November 18, is calculated to be 6·8m. or on the limit of acute unaided vision, will be distant from us 0·86—affording an opportunity which may be utilised for attempting direct measures of her diameter, though if we are not mistaken some pretty satisfactory measures were made at a favourable opposition a few years since, with a powerful refractor in this country. This planet when near the earth has a decidedly red light; at two oppositions within the last fifteen years it might be identified amongst the neighbouring stars by this circumstance alone.

CHEMICAL NOTES

ABSORPTION OF LIGHT IN THE BLOOD.—In a number of cases of unintentional poisoning caused by carbon monoxide in Berlin during the past winter, oxygen has been used as an antidote. Dr. Baeblich, of Berlin, lately showed the desirability of the method by means of spectroscopic proof in a public lecture. As is well known, the spectrum of blood shows two well-defined bands between Fraunhofer's lines D and E. By the absorption of CO the position of these bands is very slightly changed in the direction of the red part of the spectrum. The difference is more strikingly shown by the addition of sulphide of ammonium. In the case of healthy blood the two bands of the spectrum disappear and are replaced by a single one situated midway between the positions of the former pair. Blood poisoned with CO shows no change in the bands by the same treatment. If oxygen is, however, added to it before the reduction with sulphide of ammonium, the characteristic spectrum of healthy blood is at once produced.

PHYSICAL PROPERTIES OF GALLIUM.—M. Lecoq de Boisbaudran has introduced a new method for the extraction of this metal, and has investigated some of its physical properties. Its crystalline form is octahedral; the mean of six experiments gave as its melting point 30·15. Its specific gravity is 5·956; when fused it has a silver lustre, but on solidifying it shows a tinge of blue, losing its brilliancy. It is hardly acted on by nitric acid when diluted with an equal bulk of water.

POTASSIUM TRI-IODIDE.—Mr. G. S. Johnson has recently published an investigation on this body, which is prepared when a strong solution of potassium iodide is saturated with iodine, and the resulting liquid allowed to evaporate slowly over oil of vitriol. The crystals are sometimes long and isolated, sometimes appearing as hexagonal plates exhibiting a stepped arrangement like those of potassium iodide. They have a steel-blue lustre, are very deliquescent, fusing at about 45° C., and have a specific gravity of 3·498. When the temperature is raised above 100°, iodine is freely evolved from the crystals, a white mass of potassium iodide alone remaining. On analysis the crystals yielded 90·2 to 90·4 per cent. of iodine and 9·2 per cent. of potassium; the theoretical quantities required, supposing the body to be KI_3, are iodine 90·692 per cent. and potassium 9·307 per cent. An excess of water decomposes potassium tri-iodide, with precipitation of the most of the iodine; the crystals, however, may be dissolved in small quantities of water or alcohol, and recrystallised over sulphuric acid.

SOLUTION OF GASES IN IRON, STEEL, AND MANGANESE.—MM. Troost and Hautefeuille have published in the *Ann. Chim. Phys.*, [5] vii., a reprint of their researches on this subject, previously published in other journals. When cast iron is fused in contact with silica or silicates, carbonic oxide is produced by the action of the iron carbide on silica; the iron thus becomes richer in silicon, the carbon diminishing. Melted cast iron seems to occlude considerable quantities of hydrogen, this occlusion being increased by the presence of manganese and diminished by the presence of silicon. Carbonic oxide is not taken up to so great

an extent as hydrogen by melted cast iron, its occlusion is almost entirely prevented by the presence of manganese. Gases are retained by pig iron after cooling, but can be extracted by heating the metal to 800°. Steel occludes less gas than cast iron, hydrogen predominating over carbonic oxide; on the other hand more carbonic oxide than hydrogen is occluded by soft iron. Finely divided iron free from gases decomposes water slowly at the ordinary temperature, rapidly at 100°, the decomposition being more rapid the finer the state of division of the iron.

NOTES

THE golden Baer medal was awarded this year, by the St. Petersburg Academy of Sciences, to Prof. Bunge, for his various works upon the flora of Russia. The Lomonosoff premium, value 1,000 roubles, was awarded to Prof. Beilstein, of Kazan, for researches on the properties of bodies of the benzoil series.

M. ANDRÉ, the astronomer who was sent by the French Institute to New Caledonia to observe the transit of Venus, has been appointed director of the new observatory established at Lyons by M. Waddington.

AT the half-yearly General Meeting of the Scottish Meteorological Society, held yesterday, the Duke of Richmond was elected President. The following papers were read:—1. On methods of estimating ozone and other constituents of the atmosphere, by Mr. E. M. Dixon, B.Sc., Office of Health, Glasgow. 2. On the peculiarities of the weather of December and January last, by Mr. Buchan, Secretary. 3. Observations of rainfall at sea on board ship, by Dr. Black, Surgeon-Major.

THE Report of the Treasury Meteorological Commission appointed in the autumn of 1875 has now been published. The chief recommendations are that ocean meteorology be transferred from the Meteorological Office to the Admiralty, that the annual Parliamentary Grant be increased from 10,000*l.* to 14,500*l.*, and that, in addition to the above, some pecuniary assistance, the amount not being specified, be given to the Scottish Meteorological Society, on whose claims to Government support the Commission was specially instructed to report.

WE recently announced (p. 116) that the city of Brunswick was making preparations to celebrate the 100th anniversary of the birth of Carl Friedrich Gauss, the "prince" of mathematicians, who was born in that city on April 30, 1777. It is proposed to erect a monument in Brunswick to Gauss, and from the circular which has been sent us we learn that the Monument Committee consists of the principal officials of the city, civil, professional, and commercial. No doubt many English men of science might wish to contribute to this monument; contributions should be addressed to the Gauss Monument Fund, Brunswick Bank.

WE can do no more this week than refer to the fact that the Oxford and Cambridge Universities Bill passed the second reading on Monday, as might have been expected, practically without opposition. The Bill does not differ essentially from those introduced last year in reference to the two Universities.

THE fourth Congress of Russian Archæologists will be opened on August 12, at Kazan. All communications should be addressed to Count Ouvaroff, at the Moscow Archæological Society.

WE are glad to hear that the founding of a Russian Anthropological Society at St. Petersburg may be considered as finally settled. Certainly many Russian scientific bodies have now special anthropological sections which, as for instance that of the Moscow Society of Friends of Natural Science, have done a good deal of valuable work, but it is also very desirable that the separate efforts of Russian anthropologists be more concentrated than they are at present.

THE Senatus Academicus of the University of St. Andrews have conferred the degree of LL.D. upon Dr. B. W. Richardson, F.R.S., and Dr. James Murie, F.L.S.

IN a small *brochure* recently published, Prof. Ragona, of the Royal Observatory of Modena, advocates the formation of an "Italian Meteorological Society." There are at present mor than 100 meteorological stations throughout the peninsula, at various heights from the sea-level to 2,550 metres. Most are occupied also with magnetic observations; some are devoted almost exclusively to seismometry. The Minister of Agriculture, Industry, and Commerce publishes an *Italian Meteorological Bulletin*, and the Naval Minister sends out daily intimations of the state of the atmosphere throughout Europe, and of probabilities of weather. The proposed Society might hold an annual congress now in one city, now in another, and might, like the Austrian, receive a grant from Government.

DR. GABRIEL, of the University of Breslau, a well-known morphological investigator, has been sent by the Berlin Academy of Sciences to Naples to carry on for four months an extended series of observations on microscopic marine organisms. The necessary funds have been granted partly by the Academy and partly by the Prussian department of instruction.

THE Great Northern Railway Company have a bill now before Parliament for the construction of a line of railway from Shepreth to March, which will pass at a distance of not more than 1,700 feet from the Cambridge Observatory. From the experience of other observatories, and from the evidence of private letters, which Prof. Adams has received from several eminent astronomers, the Syndicate have strong reason to believe that the passage of trains, so near the Observatory, would very seriously affect the accuracy of the observations, or even cause their entire loss. The Syndicate therefore recommend, on good grounds, that the University should petition Parliament against the passing of the bill above referred to.

RUSSIA expended 345,000*l.* upon her seven universities during the past year.

OF the 13,356 new works issued in Germany during the past year, 848 were devoted to the natural sciences, 296 to geography and travel, and 190 to mathematics and astronomy.

IT is proposed to open before long a good aquarium at St. Petersburg. The institution is patronised by the Society of Acclimatisation, which will have, in connection with the aquarium, a garden for scientific experiments relative to the acclimatisation of plants.

THE immense number of wolves in Russia, to which reference was made some time ago, seems not to have been overrated. An official report of the *Zemstvo* of the Kerensk district (Penza Government), just published, estimates the ravages of wolves during the years 1874 and 1875 at 270 horses, 200 cows, 822 foals, 707 calves, 1,812 sheep, about 1,000 pigs, 3,616 geese and ducks, and 253 dogs.

WE recently announced the death of the eminent American palæontologist, Mr. F. B. Meek. He died within the walls of the Smithsonian Institution, where he had been permitted to occupy rooms for about eighteen years. He had been connected with the U.S. Geological and Geographical Survey of the Territories for the greater portion of the time since its first organisation in 1867. Mr. Meek was born in the city of Madison, Ind., December 10, 1817. From his earliest recollection he was interested in the Silurian fossils so abundant in the rocks of the neighbourhood of his home. He had then never heard of geology, but studied them with admiration and wonder as to their origin. Against his own wishes he entered into business, but during the financial crisis of 1847 he failed,

and lost all his property. During the years 1848 and 1849 he was an assistant of Dr. D. D. Owen in the U.S. Geological Survey of Iowa, Wisconsin, and Minnesota, after which he returned to Owensboro, Ky. In 1852 he became the assistant of Prof. James Hall, the eminent palæontologist, of Albany, N.Y. He remained there until 1858, with the exception of three summers, two of which he spent in the Missouri State Geological Survey. In the summer of 1853 he was sent by Prof. Hall with Dr. Hayden as his associate, to explore the "Bad Lands" of Dakota, and brought back very valuable collections. This was the commencement of that long series of successful explorations of all portions of the west which have continued up to the present time. While at Albany he was constantly engaged in the most important palæontological works, the results of which were published in the proceedings of the American learned societies. In 1858 he went to Washington, where he resided until the time of his death, leaving the city only for a few months at a time, while engaged as palæontologist for the State of Illinois, Ohio, or in field explorations in the far west in connection with the U.S. Geological Survey under the direction of Prof. Hayden. His publications, apart from the State reports referred to, were very numerous, and bore the stamp of the most faithful and conscientious research. They are regarded all over the world as authority on the subjects of which they treat, and in very few cases have his conclusions ever been questioned. They may be found in the *Proceedings of the Academy of Natural Sciences*, Philadelphia, *American Journal of Science*, New Haven, *Albany Institute*, *Smithsonian Contributions*, and various and important reports in the publication of the U.S. Geological Survey for the Territories with which he was so long connected. He was so modest and retiring that he was scarcely known outside of a very limited circle of friends. He was a member of the National Academy of Sciences, and many other prominent scientific associations in America and in Europe. Prof. J. D. Dana, writing the day after his death, says: "American palæontology has lost, as regards the Invertebrate Department, half its working force at a blow. He has gone before his work was done. But what he had finished was enough for half-a-dozen ordinary men; a marvellous pile, if we view only the aggregate of volumes and memoirs, but far more marvellous when we look within at the amount of laboured descriptions and careful comparisons, and at the almost numberless illustrations, mostly from his own exact and beautiful drawings."

ON Saturday, at the Society of Arts, Dr. Corfield, under the auspices of the Trades Guild of Learning, gives the next of the series of lectures on the Laws of Health. These lectures have been well attended and appreciated from the first. Prof. Huxley was chairman on the first occasion, Dean Stanley on the second, and at the lecture on February 10 Cardinal Manning presided. The Cardinal, after the lecture, heartily endorsed the statements of the lecturer; the lecture, he said, showed that the highest science came into the closest application in daily life. There are eight other lectures of the course.

THE educational and scientific institutions inaugurated by the Khedive of Egypt in his schemes of reform are among the first to feel the effects of the present chaotic condition of Egyptian finances. Not long since the free public schools of Cairo were all closed, and now the vice-regal Geographical Society is upon the point of dissolution. The Khedive had gathered together several men of talent and experience to form this Society, with the intention of instituting an active and energetic scheme of exploration in Central Africa. Their names and the bulletins which have appeared, gave every promise of early and valuable additions being made to the cause of African research. The long-continued withholding of financial support has, however, so entirely crippled its operations, that the Society has for some ime practically ceased to exist.

THE last contribution of Karl von Baer, written ten days before his death, appears in the last number of the *Archiv für Anthropologie*, and discusses the subject of the source of the tin used by the ancients in their bronzes. The fact that the proportions of nine parts of copper to one of tin are noticeable in almost all antique bronze articles, would seem to indicate that its use spread from a single centre. Taking a hint from Strabo's statement that tin was found among the Drangians, he caused inquiries to be set on foot by Russian Government officials in Khorassan, who reported that there are extensive deposits of tin there, as well as of other metals, which are mixed in a primitive manner. These v. Baer regards as the sources of the numerous bronzes found in the ruins of Babylon and Assyria, but did not think it probable that they supplied the tin required by Scandinavia and the countries surrounding the Mediterranean before the discovery of the Cornish mines. The latter was probably brought by Phœnicians from Banca, although no mention of such journeys is extant.

IN the February session of the Berlin Anthropological Society Prof. Virchow gave the results of a number of craniological measurements undertaken in Bulgaria. The general type is evidently not Slavonic but Finnish, and would seem to point to a distant emigration from among the Turco-finnish tribes of the Ural, to the region of the Danube. Two distinct subordinate types were noticed, one brachycephalic—pure Finnish; and the other macrocephalic, with retreating forehead, strikingly similar to that of the Australian negro. The Bulgarians gradually adopted the Slavonic language, and no trace of their original language, not even a manuscript, remains. Dr. Friedel exhibited at the same Session a large collection of stone hatchets lately found near Köpenick, in company with some peculiarly fashioned stone instruments, evidently used to prepare the hatchets, and possessing the same hardness as ordinary grindstones.

A TELEGRAM from Algiers announces that on the 16th inst. Lieut. Say and others left Ouarghe with twenty-four men and fifty camels, intending to explore the Sahara, and establish commercial connections with Algerian producers.

M. KRANTZ, the Director-general of the Universal Exhibition of 1878 proposes to hold an international piscicultural exhibition. All who desire to exhibit must intimate their intention to the Secretary before May 1, 1877. The administration does not undertake to procure sea water.

M. QUATREFAGES has just published, through Baillière, a work on anthropology. He attacks the evolution theory.

MRS. FRANCES ELIZABETH HOGGAN, M.D. of Zurich, who has been for several years in practice in London, has just passed a successful examination in Dublin, and has received the Licences in Medicine and Midwifery of the King's and Queen's College of Physicians in Ireland, which of course secure for her official recognition in the United Kingdom. A paper by Doctors George and Mrs. Hoggan was recently read at the Royal Society, on "Lymphatics of Muscles."

M. WADDINGTON intends to propose to the French parliament the establishment in four large provincial towns of universities according to the English system. The faculties at present in existence in a number of towns will not be suppressed, but they will be necessarily to some extent cast into the shade. A sharp discussion is anticipated in Parliament, many large towns competing for selection as the seats of these new universities.

THE third annual meeting of the Scientific Club was held at the Club House, Savile Row, on Thursday, the 15th inst., Major F. Duncan, R.A., D.C.L., &c., Chairman of the Committee, in the chair. The report for 1876, which showed the rapid progress

made by the Club during the year, was unanimously adopted. The number of members, which is now over 600, is to be limited for the present to 700. Committee-men and auditors for 1877 were elected, and cordial votes of thanks to the Chairman, Committee, Auditors, and Secretary, concluded the meeting.

AT the annual meeting of the shareholders of the Brighton Aquarium, Mr. Arthur Wm. Waters stated his belief that if arrangements were made so that a naturalist could go to Brighton and have a table in a quiet room with the most necessary apparatus and chemicals for his study, animals kept living, and fresh ones brought him as required by the sailors under the instruction of the scientific staff, there are many who would gladly avail themselves of the opportunity. The difficulties of a naturalist at present who may go down to the sea-side for a short time to undertake elaborate physiological studies are very great, and he thinks that many, including science students from the universities, would be willing to pay for the advantages which might thus be afforded. Mr. Francis Francis, who has just been appointed naturalist director, said that it was intended to do this; and even to hear of the intention will be a source of satisfaction to those who desire the present aquaria to be made more useful. We hope that if the directors have any suitable place they will not delay to utilise it, and that it may turn out to be a source of permanent advantage, for scientific research will continue when rinking and other such amusements have been replaced by more novel attractions.

THE most important paper in the February number of Petermann's *Mittheilungen* is a detailed discussion of the projects for a railway to Central Africa from the Mediterranean Coast, by Dr. G. Rohlfs. Dr. Rohlfs discusses the various schemes which have been proposed, speaks very unfavourably of that which would carry a line from Algeria southwards, and advocates strongly a line from the coast of Tripoli, especially from Braiga at the head of the Gulf of Sidra, to Lake Chad. He analyses all the difficulties and advantages of this route, and thus introduces much information on the region between these two points, as well as on the whole Saharan region. He proposes, as the only feasible plan, that the undertaking should be an international one.

IN the same number Dr. Behm continues his monthly summary of geographical news. He refers to a work by A. Kirchenbauer, "Die Irrfahrt des Odysseus als eine Umschiffung Afrika's erklärt" (Berlin, Calvary), in which the author, by the application of astronomy and mathematical geography, endeavours to show that the Kernel of the Odyssey is a tradition belonging to the fifteenth century B.C., of a circumnavigation of Africa from the Red Sea to the Mediterranean. The Lotophagi were South Arabians, Polyphemus was a Galla, whose cave was at Cape Guardafui, Circe ruled in Rodriguez, the Cimmerians dwelt in some South Polar land, and the Straits of Gibraltar were Scylla and Charybdis. Thus Ulysses was both the first African and first Polar explorer of whom we have any record. Dr. Behm states that the author discusses the subject with the greatest seriousness and acuteness.

THE December *Bulletin* of the French Geographical Society contains papers by Mr. J. B. Paquier, "On Russian and English Explorations in Central Asia;" by M. A. V. Parisot, "On the Region between Ouarglâ and El Golêa;" by Abbé Durand, "On Portuguese India;" and by Abbé Desgodins, "On the Territory of Batang." A letter from Dr. Emil Bessels, of the *Polaris* Expedition, accompanies a map exhibiting approximately the lines of equal tides in the North Atlantic, North Pacific, and Arctic Oceans, for the purpose of showing from what direction the tidal wave is propagated towards Polaris Bay.

L'Exploration for February 7 contains an interesting paper by M. Henry Bionne on the Colonial *régime* of France.

CAPT. HOWGATE'S scheme of Polar exploration by means of a colony placed at Discovery Bay, to which we referred in a recent number, has been referred by the United States Congress to the Committee on Naval Affairs. It has received the support of the principal United States scientific societies, and already there have been many suitable volunteers. We should not be surprised, therefore, to hear that the grant has been made, and if men can be found suitable and willing to form such a colony, the experiment seems worth trying.

A SENSATION has been created in the geographical circles of Paris by the opinion expressed by Dr. Pogge at the Geographical Society of Berlin, that the Lualaba was flowing in the Ogovai. The Ogovai delta is part of the French Gaboon settlement. MM. Brazza, Marche, and others are engaged in exploring the river, which they have heard from natives flows out of a large lacustrine basin. It is feared the explorers cannot reach the end of their journey without receiving fresh reinforcements from home.

THE Geographical Society of Geneva voted at its last meeting its adhesion to the resolutions of the conference, for the exploration of Central Africa. A special Swiss committee, to form part of the Association, is to be appointed before long at Geneva.

M. BONNAT, the French African explorer, who has been up the Volta (Ashanti) as far as Salaga, states that from that place much-frequented routes strike off to Timbuctoo in the west, and Lake Tchad in the east, and that from these places trade caravans are constantly passing to and from Mexico and Tripoli. He bought European goods at Salaga, which entered Africa by the Mediterranean. M. Bonnat is organising a large expedition for the thorough exploration of the region from which he has just returned.

WE are glad to notice that science was well represented at the preliminary meeting last Saturday to make arrangements for the celebration of the 400th anniversary of the introduction of printing into England by Caxton. Science owes much to this art, and in recent years has to some extent repaid her debt by the vast improvements which have been introduced, based on the principles she has discovered.

FATHER SECCHI has compiled a very useful list of 444 coloured stars, which is published in the *Memorie della Società degli Spettroscopisti Italiani*. Many of them appear to be taken from Schiellerup's catalogues, from Lalande and Sir J. Herschel; to these have been added Mr. Birmingham's newly-discovered coloured stars. A note is added to each star, showing the colour and type of spectrum. The number of the star in Chambers's catalogue is given, when mentioned there, and the R.A. and Declination is given for the year 1870. We note that by far the greater number of stars are red, and the spectra of the third and fourth types prevail. This catalogue will prove useful, first, in detecting the variability of the stars, and secondly, the change of spectrum when variable. The following are representative stars of the types to which they belong:—1. Sirius, α Lyra, white stars; 2. Capella, Pollux, yellow stars; 3. α Orionis, β Pegasi, α Herculis, red-yellow stars; 4. Small blood-red stars.

WE notice in the fifteenth volume of the *Globe*, published by the Geographical Society of Geneva, a very interesting report by M. H. D. Saussure on the present state of cartography in Switzerland. The author not only gives a detailed report on the numerous Swiss cartographical works which were so much praised at the Paris Geographical Exhibition, but also sketches the history of cartography in his country, and skilfully discusses the relative values of different modes of representing on a map the various characters of land, and of dressing maps for various special purposes.

SOME fifty years ago Ampère stated his belief in the existence of molecular electric currents permanently flowing in bodies, and he applied this hypothesis to the explanation of the reciprocal action between movable conductors through which galvanic currents are passing and permanent magnets. According to Ampère a permanent magnet contains, in proportion to its strength, a larger or smaller number of molecular currents of the same direction, each of which behaves like a small molecular magnet. In pursuance of this theory, Herr Zoellner has lately made a series of investigations and has recorded the results of his experiments in a paper read before the Royal Saxon Society of Sciences at Leipzig during the past year. With regard to the constitution of material molecules Herr Zoellner expresses his opinion "that each material molecule of a body consists of a conglomeration of (Ampère's) molecular currents of any direction, with a certain quantity of freely movable electric particles, which, under the influence of electrostatic or electrodynamic induction forces, execute such motions or groupings as are determined by Weber's law of electric reciprocal action." It is but fair to state that Weber's views on this subject were identical, and he stated them as early as in 1851 in his explanation of diamagnetism. Zoellner makes a whole series of deductions from this theory, all of which agree with observed phenomena and laws found in various domains of physical science.

THE Rev. T. R. R. Stebbing sends us an interesting letter on the true origin and correct pronunciation of the name *Antedon*, which we regret we have not space to print in full. As the result of careful inquiry, Mr. Stebbing concludes that the name is undoubtedly feminine, that the middle syllable should be pronounced long, and that the aspirate which de Fréminville dropped ought to be restored to the spelling. "If, then, we were to adopt the compromise suggested in Mr. Herbert Carpenter's important letter (vol. xv. p. 197), we should have to write, instead of either *Comatula rosacea* or *Antedon rosaceus*, the trinomial, *Comatula* (*anthedon*) *rosacea*. To sanction such an innovation as Mr. Carpenter proposes, no doubt some general agreement would be required, and the same general agreement might be usefully employed in sanctioning a statute of limitations against the revival of obsolete names, and to insure the publication of new scientific names in one or other of a very limited number of chronicles. Some international science congress of the future may perhaps achieve the requisite legislation."

THE *Journal* of the Society of Arts for February 16 contains a useful paper by Dr. R. J. Mann, on "Recent Explorations of the Lake Systems of Central Africa."

WE notice an important German work, by the Bernese Professor, Dr. Emmert, on the diseases of the eye, occasioned by various professions, and especially by the vicious arrangements in schools. An inquiry made by the learned Professor in the cantons of Berne, Solothurn, and Neuchâtel proves that an increasing myopy is the fate of all scholars, and that at the age of twenty years there are very few of them who are not afflicted with this disease. Various hints by the author as to improved arrangements to be adopted in schools deserve the attention of school boards.

A RECENT subscriber will find an account of Siemens' Bathometer in NATURE, March 30, 1876 (vol. xiii. p. 431).

THE additions to the Zoological Society's Gardens during the past week include two Pennant's Parrakeets (*Platycercus pennanti*) from New South Wales, presented by Mr. E. Sargent; an Anaconda (*Eunectes murinus*), a Crested Curassow (*Crax alector*), and two Green-billed Curassows (*C. viridirostris*) from South America; two Feline Dourocoulis (*Nyctipithecus felinus*) from South Brazil; two Cariamis (*Cariama cristata*), from South America, purchased.

SOCIETIES AND ACADEMIES

LONDON

Royal Astronomical Society, February 9.—Annual general meeting.—William Huggins, D.C.L., president, in the chair. The following gentlemen—A. Mason Worthington, B.A., John Sidney White, and George Francis Hardy, were elected fellows of the Society. The annual report of the society showed that the number of Fellows had been increased during the past year, and that the society's library had been enriched by several important presents of books and manuscripts. Ten minor planets have been discovered in the course of last year, six of them in America, and four in France. In solar physics Prof. Tacchini has made an interesting investigation as to the relative height of solar prominences at different times of the sun-spot period. Prof. Young has determined the rate of the solar rotation by means of the displacement of the dark lines in the spectrum of the sun's limb. He has also proved that the 1474 line is double, and that the two components are of unequal strength; the coronal line corresponds to the stronger of the two, whilst the other is one of the faint lines in the spectrum of iron. Mr. Huggins' photographs of the spectra of stars were also referred to, and a short account was given of the observations of the new star in Cygnus, which was discovered by Dr. Schmidt, at Athens, on November 24, 1876. Its spectrum gives several bright lines, amongst which are three of the hydrogen lines, C being the brightest of all, the sodium line D, or the chromosphere line near D, the magnesium lines *b*, and the coronal line 1474. The reduction of the observations of the transit of Venus has been proceeding continuously at the Greenwich Observatory, under the direction of Capt. Tupman. All the observations with transit instruments at the various stations for local time and longitudes of Honolulu and Rodriguez by the observations of the moon in zenith distance have been completely reduced. An idea of the magnitude of the undertaking may be formed when it is stated that these two last calculations required the use of three millions of figures. The Report having been adopted, the Society proceeded to the election of Officers for the ensuing year, and the following gentlemen were elected: As President, William Huggins, F.R.S. As Vice-Presidents: J. C. Adams, F.R.S., Lowndean Professor of Astronomy, Cambridge; Sir G. B. Airy, K.C.B., F.R.S., Astronomer Royal; Arthur Cayley, F.R.S., Sadlerian Professor of Geometry, Cambridge; Edwin Dunkin, F.R.S. As Treasurer, Samuel Charles Whitbread, F.R.S. As Secretaries: J. W. Lee Glaisher, F.R.S.; A. Cowper Ranyard, M.A. As Foreign Secretary, Lord Lindsay, M.P. As Council: John Brett, Esq.; W. H. M. Christie, M.A. Warren De La Rue, F.R.S.; J. R. Hind, F.R.S., Superintendent of the *Nautical Almanac*; E. B. Knobel; George Knott; William Lassell, F.R.S.; E. Neison; Capt. Wm. Noble; Rev. S. J. Perry, F.R.S.; Earl of Rosse, F.R.S.; Capt. G. L. Tupman, R.M.A.

Geological Society, January 24.—Prof. P. Martin Duncan, M.B., F.R.S., president, in the chair.—George Barrow, William Heerlein Lindley, and Joseph Samuel Martin, were elected Fellows of the Society.—The following communications were read:—Note on the question of the glacial or volcanic origin of the Talchír boulder-bed of India and the Karoo boulder-bed of South Africa, by H. F. Blanford, F.G.S. The author, referring to a doubt expressed by the President in a paper on Australian tertiary corals as to the glacial origin of the Talchír boulder-bed, indicated that the hypothesis of its formation by the action of local glaciers under present climatal conditions would require the elevation of the whole region to the extent of 14,000 or 15,000 feet, and the assumption that the denudation of this great mountain mass was so moderate that large tracts of the ancient surface are still preserved at levels now only a few hundred feet above the sea. This the author regarded as very improbable. He assumed that the President, rejecting the evidence adduced by various writers in favour of the glacial origin of the Talchír and Karoo boulder-beds, was inclined to fall back upon the notion of their being of volcanic origin, and quoted a letter from Mr. King, who had described he Talchír rocks of Kámáram as trappean, in which that gentleman stated that the rocks so interpreted by him prove to be dark green and brownish mudstone. He cited further evidence of like nature, and concluded that the ascription of a volcanic origin to these boulder-beds was probably in all cases due to similar misinterpretations.—On British cretaceous patelloid gasteroporada, by John Starkie Gardner, F.G.S. In this

paper the author commenced by a general statement as to the classification of the forms to be described in it, which he referred to the families Patellidæ, Fissurellidæ, Calyptræidæ, and Capulidæ. He noticed thirty species, which are mostly of rare occurrence, and nineteen of these were described as new. Four genera were indicated as new to the Cretaceous series, and one as new to the Cretaceous in England. The new species were *Acmæa formosa* and *plana*, *Helcion Meyeri*, *Anisomyon vectis*, *Scurria calyptræiformis* and *depressa*, *Emarginula puncturella*, *divisiensis*, *ancistra*, *Meyeri*, and *unicostata*, *Puncturella antiqua*, *Calyptræa concentrica*, *Crepidula chamæformis*, *Crucibulum giganteum*, *Pileopsis neocomiensis*, *dubius* and *Seeleyi*, and *Hipponyx Dixoni*. Most of the Patellidæ were from the Neocomian, and the majority of the Fissurellidæ from the Upper Greensand; the species of the other two families were scattered through the series. The author referred to the indications of depth of deposit and other conditions furnished by these Mollusca, and also to the resemblance presented by many of them to certain bivalves common in the same rocks, which he regarded as a sort of mimicry.—Observations on remains of the mammoth and other mammals from Northern Spain, by A. Leith Adams, F.R.S.—The remains noticed in this paper were obtained by MM. O'Reilly and Sullivan in a cavern discovered at about twelve metres from the surface, in the valley of Udias, near Santander, by a boring made through limestone in search of calamine. They were found close to a mound of soil which had fallen down a funnel at one end of the cavity, and more or less buried in a bed of calamine which covered the floor. The cavern was evidently an enlarged joint or rock-fissure, into which the entire carcases, or else the living animals, had been precipitated from time to time. The author had identified among these remains numerous portions, including teeth of *Elephas primigenius*, which is important as furnishing the first instance of the occurrence of that animal in Spain. He also recorded *Bos primigenius* and *Cervus elaphus* (?), and stated that MM. O'Reilly and Sullivan mention a long curved tooth which he thought might be a canine of Hippopotamus.

Chemical Society, February 15.—Dr. Gilbert, F.R.S., vice-president, in the chair.—Dr. Dupré, F.R.S., read a paper on the estimation of urea by means of hypobromite, in which he described a new form of apparatus and certain modifications in details to facilitate the working of Russell and West's process. The other communications were on a new carbometer for the estimation of carbonic anhydride, by Mr. S. T. Pruen and Dr. G. Jones, being a modification of Scheibler's "calcimeter."—On the influence exerted by ammonium sulphide in preventing the action of various solutions on copper, by Mr. F. W. Shaw and Dr. P. Carnelly.—An experimental inquiry as to the changes which occur in the composition of waters from wells near the sea, by Mr. W. H. Watson.—On the solvent action of various saline solutions upon lead, by Mr. M. M. P. Muir.—Derivatives of Di-sobulyl, by Mr. W. Carleton-Williams, and notes on madder-colouring matters, by Dr. E. Schunck and Dr. H. Roemer.

STOCKHOLM

Academy of Sciences, October 11, 1876.—Baron Fock gave an account of a report by O. Nylander, assistant at the Academy of Agriculture, of a journey he had undertaken with the Letterstedt grant for the purpose of studying the industries associated with agriculture.—Prof. Torell also gave an account of a report by Edward Erdman, the geologist, of a tour he had made, with Government assistance, in Central Europe in 1875.—Prof. Smith gave a short account of the expedition to North-western Russia and the region round the White Sea, undertaken by Lieut. H. Sandeberg last summer.—Prof. Stål stated that the Vylder collections had been bought for the natural history department of the Riks Museum, through the liberal contributions of private persons, and gave a short account of their contents.—General-director Berlin communicated the result of the latest analyses by Valler of the mineral water at Porla, and Prof. Nordenskjöld gave a full and interesting narrative of his last expedition from Tromsö to Jenissei.—The following communications were received:—On the course of the alteration which a surface undergoes when it is bent, by Prof. Daug.—On compounds of cyanide of mercury with chlorides of the earthy metals, by J. E. Ahlén.

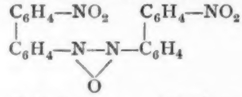
November 8, 1876.—Herr Edlund communicated the results of his examination of the galvanic currents which are caused by the motion of fluid bodies.—Prof. Nordenskjöld exhibited pieces of a mammoth or fossil rhinoceros hide, found last summer near the confluence of the Mesenkin with the Jenissei, and several meteorites which fell at Ställdalen, in Westmanland, on the 28th of last June, and gave an account of the nature of the meteorites in question.—Herr Gyldén exhibited a calculating machine constructed by Engineer Pettersson for the purpose of adding, subtracting, multiplying, and dividing, and gave an account of a communication by Prof. T. N. Thiele, of Copenhagen, entitled, "Some geometrical propositions concerning a problem in theoretical astronomy."—The following papers were communicated: A new species of the family Portunidæ from the Scandinavian coast, by Docent Carl Bovallius; Communication from Upsala Chemical Laboratory, 20, on *g* (gamma) dichloronaphthaline and bromo-chloronaphthaline, by Prof. P. T. Cleve; Remarks on Dr. Bioren de Haans Tables d'intégrales définies (Amsterdam, 1858), by Lektor Lindman, member of the Academy; and Researches on the cooling of bodies, by Prof. G. R. Dahlander.

BERLIN

German Chemical Society, January 29.—A. W. Hofmann, vice-president, in the chair.—W. Beetz claims priority for observing the disengagement of hydrogen at both poles of a battery (as lately described by Elsässer).—W. Bornemann published observations on the solubility of chloride of iodine, and R. Ulbricht some on the determination of water and of sugar in wine. The latter chemist gives warning of a fraud by which glass weights are sold instead of ones made from rock crystal.—R. Dyckerhoff has transformed monochloro-acetophenone, $C_6H_5—CO—CH_2Cl$, by the action of PCl_5 into two chlorides:

$$C_6H_5 . CCl_2 . CHCl \text{ and } C_6H_5 . CCl . CHCl;$$

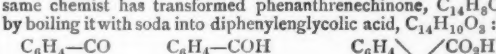
—V. Meyer, T. Barbieri, and F. Forster by joint and elaborate researches refute the pretended observation of Linnemann and Zotta that *normal butylamine* and nitrous acid yield *isobutylic* alcohol. The reaction only yields normal primary butylic alcohol, normal butylene, and normal secondary butylic alcohol, but no isobutylic alcohol.—H. Wald has transformed paradinitrodiphenyl by the action of sodium-amalgam into paradinitro-azoxydiphenyl, a crystalline powder melting at 255°, and soluble



in aniline, but not in alcohol, ether, or chloroform, and yielding benzidine by further reduction with tin and hydrochloric acid. Isodinitrodiphenyl and sodium amalgam yield dinitro-azodiphenyl, $(C_6H_4NO_2—C_6H_4N)_2$, a yellow powder melting at 187°.—C. Kimich published researches on methazonic acid, the sodium-salt of which is engendered by the action of heat on nitromethan-sodium:—

$$2CH_2NaNO_2 = NaOH + C_2H_3NaN_2O_3.$$

This salt with nitrate of diazobenzol, yields red crystals of a mixed azo-compound, $C_6H_5N_2 . C_2H_3N_2O_3$ (azonitromethalphenyl), in which two atoms of hydrogen can be replaced by metals. Nitrate of diazotoluol gives a corresponding compound.—G. Burkhardt has transformed amidoterephthalic into oxyterephthalic acid (with nitrous acid), a powder giving a crystallised barium salt and methylic ether. Hydrochloric acid transforms it into oxybenzoic (not salicylic) acid.—A. Baeyer has studied amidophthalic acid and its well-crystallised ethylic ether, which, with nitrous acid, yields an ill-defined oily oxyphthalic acid. The same chemist has transformed chloride of phthalyl into phthalic aldehyde by treating it with hydriodic acid and phosphorus. With potash it yields a new acid not yet investigated. The same chemist has transformed phenanthrenechinone, $C_{14}H_8O_2$, by boiling it with soda into diphenylenglycolic acid, $C_{14}H_{10}O_3$:—



Phenanthrenechinon. Diphenylen-glycolic acid.

He rejects the former formula of the latter body, because it does *not* yield by oxidation diphenic acid.—G. Schultz, by passing oil of turpentine through red-hot tubes, has obtained benzol, toluol, xylol, naphtalene, phenanthrene, anthracene, and methylanthracene.—F. Hermann has studied the action of sodium on succinic ether. The product (probably impure succino-succinic ether) yields, treated with potash and with acetic acid, an acid of the composition

Ethyl-succinyl-succinic acid,

while with sulphuric acid it forms a black amorphous mass, which by distillation yields hydrochinone. The product of potash with bromine gives bromanile $C_6Br_4O_2$. Air and potash transform the ether into $C_6H_4O_2(CO_2H)_2$ chinon dicarbonic acid, yellow hair-like crystals.—E. Schunck and H. Roemer, in order to discover traces of alizarine in purpurine, expose the solution to the air until the latter is oxidised, when alizarine, remaining behind unaltered, can be recognised by its absorption-bands in the spectroscope. The same chemists have found that certain impure purpurines yield a precipitate with alum, which is decomposed by hydrochloric acid with greater difficulty than the purpurine compound. The compound thus obtained forms gold-brown needles fusing at 231° decomposed by heat into carbonic anhydride and purpuroxanthin, and corresponding to the formula of purpuroxanthincarbonic acid $C_{14}H_8O_4COOH$.—A. Kern published researches on the action of iodide of methyle on aniline, from which he concludes that only dimethyl-aniline and no monomethyl-aniline is formed in this reaction.—R. Meyer has tried in vain to convert cuminol into cymol; and thinks that former assertions to the contrary depend upon the presence of preformed cymol in cuminol.—M. Muencke (of the firm of Warmbrunn and Quilitz, in Berlin) showed a model of a double aspirator, also a Bunsen burner with a tube to prolong it, and a modification of Fletcher's hot air blast.—G. Gabriel described phenylic and ethylic ethers of tribasic thioformic acid, $CH(SR)_3$, obtained by the action of chloroform on the sodium compounds of the corresponding mercaptans.—A. Klobukowsky showed a tube filled with oxide of iron for E. Kopp's method of determining chlorine, bromine, and iodine in organic compounds, and praised the simplicity of this method.—A. Czech and H. Schwebel have found that isocyanide of phenyl and formic acid are formed by the action of dichloracetic acid on aniline.—A. W. Hofmann showed a new yellowish-red colouring substance called chrysoidine, and established the following remarkable analogies:—

$C_{12}H_{11}N_3$ Martius yellow = Amidoazobenzol,
$C_{12}H_{12}N_4$ Chrysoidine = Diamidoazobenzol,
$C_{12}H_{13}N_5$ Phenylene brown = Triamidoazobenzol.

The first body is obtained by the action of nitrous acid on aniline; the third by the action of nitrous acid on phenylene diamine; the new colour (chrysoidine) by the action of phenylen diamine on newly-prepared diazobenzole in alcoholic solution.

VIENNA

Imperial Academy of Sciences, November 9, 1876.—On parthenogenesis of angiospermous plants, by M. Kerner.—On the shell-glands of Copepoda, by M. Claus.—On a modification of Dumas' method of determination of vapour-densities, by M. Habermann.—Researches on the origin of the lowest organisms, by M. Krasan.—On the action of secondary electric currents on nerves, by M. Heischl.

PARIS

Academy of Sciences, February 12.—M. Peligot in the chair.—The following papers were read:—Discovery of three small planets, 170, 171, and 172, and of a comet, at Toulouse and Marseilles, by MM. Tisserand and Stephan, communicated by M. Leverrier.—Researches on calorific spectra (continued), by M. Desains. With refracting apparatus of rock salt, the heat accompanying the luminous rays in the solar spectrum is about a third of the total heat; in the spectrum of incandescent platinum it is only a small fraction. Similar results are had with flint apparatus, and M. Desains was unable to make the difference disappear by sending the rays from the metal through layers of water, though this shortened the dark spectrum. But spectra from the electric lamp may be rendered much more like those obtained from the sun's rays. The heat in their luminous part seems to be about one-sixth of the total heat, and if the rays be sent through a layer of water of 3 to 4 cm., the calorific intensity of the dark part is considerably reduced, while the luminous heat is hardly affected; this latter being then about a third of the total heat as in the solar spectrum.—Preliminaries of a study of living and fossil European oaks, compared together, by M. De Saporta. The races most largely distributed in Europe, particularly *Quercus pedunculata*, *sessiliflora*, and *pubescens*, are comparatively recent, though their type is old. In the south of France, at least, these have been preceded by other oaks, that have been partly eliminated, partly confined further southwards.—On a new catalogue of coloured stars, and on the spectrum of Schmidt's star, by P. Secchi. This work is based on Schjellerup's catalogue, published in 1866.—Observations on the *compte rendu* of the *séance* of February 5, 1877, by Gen. Morin. He expressed regret at the omission from *Comptes Rendus* of information given by MM. Wurtz, Pasteur, and Boussingault on certain falsifications of alimentary substances, and urged the importance of the subject, and of chemistry detecting such frauds. M. Pasteur stated that of fourteen cases of preserved peas bought at random in some of the principal quarters of Paris, ten contained copper, sometimes even about $\frac{1}{10000}$ of the total weight of the preserves, excluding the liquid; which always contains some copper when the peas contain it, but less.—M. Lory was elected correspondent for the section of mineralogy, in place of the late M. Naumann.—On the application of photography to observation of the transit of Venus, by M. Angot. This relates to determination of the instant of contacts.—Practical formulæ of velocities and pressures in arms, by M. Sarran.—On a class of orthogonal systems, comprising isothermal systems as a particular case, by M. Darboux.—On nitrification by organised ferments, by MM. Schlœsing and Müntz. He obtained nitrification by passing ammoniacal waters through a porous substance charged with organic matters, but there was no trace of nitrate from a filter made of pure sand. The active matter, after being subjected to action of chloroform, lost its nitrifying properties exactly as if these special ferments had been killed.—Note on certain alterations of glass, by M. de Luynes. Often, in moist air, fine parallel striæ form on the surface, and scales come off, which are found to be of different composition from the glass. Alkalies are almost wholly absent in them, and they consist chiefly of earthy silicate; the proportion of silica rising to 78 per cent., while in normal glass it is only 68. The glass retains its transparence.—On phosphorescent organic bodies, by M. Radziszewski. Hydrobenzamide, amarine, lophine, and the raw product of the action of alcoholic ammonia on benzile show phosphorescence in the dark when brought into contact with an alcoholic solution of caustic potash.—On the fermentation of urine; reply to M. Pasteur, by Prof. Bastian.—On the toxical properties of salts of copper, by M. Bergeron.—Method for recognising iodine in cod-liver oil and experiments on absorption of iodide of potassium by fatty animal matters, by M. Barral. He saponifies the fatty matter with potash, burns the soap, and dissolves in alcohol the iodide of potassium formed. A goat received fifty centigrammes of iodide of potassium daily for eight days with its food. Butter prepared from its milk contained a good deal of iodine. The kid of a goat thus treated being killed, iodine was found in its fat and adipose tissue.—Researches on the history of respiration in fishes, by M. Jobert. He finds a peculiar respiratory system in the Callichthys.—On the transparence of the water of Lake Leman, by M. Forel. He explains the less transparence in summer than in winter, by a stratification of layers of different densities, due to heat on the surface; in winter there is uniform density, and powdery particles either sink to the bottom or rise to the surface.

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